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The objects of the American Geographical Society are to collect and disseminate geographical information by discussion, lectures, and publications; to establish in the chief city of the United States a place where may be obtained accurate information on every part of the globe; and to encourage such exploring expeditions as seem likely to result in valuable discoveries in geography and the related sciences.

The American Geographical Society is the oldest geographical society in the United States. When it was founded, in 1852, there were but twelve similar societies in the world. Now it exchanges publications with more than four hundred scientific associations. The Society issues a ~~monthly~~ quarterly magazine of unusual appeal, *The Geographical Review*, which contains authoritative articles of general interest. It has also a large and growing library—one of the most important geographical libraries of the world; thousands of maps and charts; and a remarkable collection of atlases of the sixteenth, seventeenth, and eighteenth centuries.

Travelers, men of science, and others properly accredited are welcome at the rooms of the Society and may freely use the book and map collections.

Two gold medals have been founded by the Society, the *Cullum Geographical Medal* and the *Charles P. Daly Medal*, which are awarded from time to time to explorers, writers, and men of science who have contributed to the advance of geographical knowledge.

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The qualifications for fellowship are an interest in exploration and travel, in the spread of geographical knowledge, and in the advancement of science.

A Fellow is entitled to the use of the library, reading and map rooms; to admission to all lectures and exhibitions; to *The Geographical Review;* and to the Society's special publications, which include occasional books and maps.

The annual dues are ten dollars.

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THE GEOGRAPHICAL REVIEW

VOL. XI JANUARY, 1921 NO. 1

ANNOUNCEMENT

The Society announces a change in the form and character of its publications incident upon the adoption of a program of intensive research. With this issue the *Geographical Review* ceases to be a monthly periodical and becomes a quarterly to be issued in January, April, July, and October.

Parallel with the *Review* there will be issued a Research Series. Of fourteen numbers of the series already projected, two are in press (to be distributed in a few weeks), and several others will be printed in the early months of the current year. The scope is comprehensive, and the contributions for the most part will be original in character. The first of the series is Bering's Voyages by Professor F. A. Golder. It contains the logbook of the famous voyage of exploration of 1741, a map of Bering's course as compiled by Captain Commandant E. P. Bertholf of the U. S. Coast Guard [retired], reproductions of old maps to illustrate the state of geographical knowledge of the North Pacific before Bering's time, and the historical and geographical setting of the problem by Professor Golder. The second volume in the series deals in the same manner with Steller's Journal. The third volume is a geographical study of the relation of topography to strategy as illustrated by actual examples from the battle fields of the late war ranging from the North Sea to the Balkans. Professor D. W. Johnson, the author, a Major in the United States Army, visited the chief theaters of action during 1918, and in this book, illustrated with many maps and photographs, he has made to the subject of military geography a contribution of the first importance. Other volumes of the Research Series will be announced as published.

The Society, with the co-operation of the National Research Council, is preparing to publish a set of three maps of Africa dealing respectively with soils, vegetation, and land classification. These maps have been compiled on the scale of 1 : 5,000,000 by Messrs. C.F. Marbut of the U. S. Bureau of Soils and H. L. Shantz of the U. S. Bureau of Plant Industry after a systematic examination of a large collection of published material supplemented by study in Africa by Mr. Shantz lasting over a year. It is hoped that this, the

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first document of the kind, will have a world-wide interest and utility, although it is of course largely preliminary in character.

The time is opportune for a published announcement of the Society's plans for research in the geography of Hispanic America. The proposed work, of which a brief outline was presented at the April, 1920, meeting of the Association of American Geographers and the Society and shortly thereafter to the National Research Council, Division of Geology and Geography at Washington, includes the preparation of a number of monographs and handbooks on selected regions and special geographical topics relating to the Hispanic American realm and Brazil. The work will involve the compilation and publication of maps—topographic and distributional—on various scales, but always including sheets on the scale of 1:1,000,000 which will conform to the scheme of the International Map.

The program further includes the production of complete distributional maps of Hispanic America similar to the maps of Africa referred to above.

The program has been initiated with Mr. Alan G. Ogilvie, formerly of the University of Manchester, England, in immediate charge. Professor F. J. Teggart, of the University of California, will have charge of the section of historical geography. Mr. G. M. McBride, former Librarian of the Society, has undertaken a part of the program, being engaged at present upon the question of land tenure in its geographical aspects. Various assistants have also been appointed, including scholars from several South American countries.

To meet the technical map requirements there will be established at the Society a School of Surveying. The School, which will be opened to students October 1, 1921, will be under the direction of Dr. Alexander Hamilton Rice, a recent Gold Medalist of the Society and now one of its Vice-Presidents. It is proposed that graduates of the School shall be engaged in part in field surveys of high quality from which there will result improved topographic data for the regions selected for geographic study.

To insure the success of the undertaking the co-operation of the whole group of Hispanic American countries is contemplated. The Society is happy to say that assurances of such co-operation have been given in a cordial spirit that augurs well not only for immediate scientific results but also for the fostering of mutual understanding and sympathetic relationship towards which the field of geography offers a peculiarly fortunate approach.

NOMAD AND SEDENTARY FOLKS OF NORTHERN AFRICA

By E. F. GAUTIER
University of Algiers

For the last 20 years I have been familiarizing myself with the Algerian Sahara. A recent journey in Egypt has drawn my attention to the differences between the eastern and western portions of the great desert. From the human point of view the essential difference lies in the relations between the nomad and sedentary folk.

The Algerian Sahara

In its entirety the French Sahara occupies not less than half the area of the United States.[1] The map, Figure 1, accompanying the present article represents the best known part, the northeastern corner conventionally described as the Algerian Sahara. It is of the inhabitants of this region that I here propose to speak.

The physical stamp of this part of the Sahara, as I have elsewhere pointed out,[2] is its skeleton framework of great Quaternary wadis. Strictly related to the existence of these wadis are the pasture grounds of the nomads. Sometimes the floor of the wadis is carpeted with the xerophilous plants upon which the camel browses. But there is also a vegetation of the dunes. The dunes, or *ergs*, are the alluvium of vanished rivers accumulated in the basins by eolian transportation.

TUAREGS AND SHAMBAS

These two great categories of pasturage, that of the wadis and that of the dunes, correspond to a distinction of nomadic tribes: Tuareg in the one case, Shamba in the other. Of course this does not mean that the Tuaregs never pasture their camels on the dunes nor the Shambas in the wadis; but broadly speaking the Shambas are nomads of the *erg*, the Tuaregs of the rocky plateaus. It is a fact that the camels of the Shambas, accustomed to treading sand, wound their feet on the rocks of the wadis far more than does the Tuareg camel.

The most important point of distinction in the relations of these nomads is a matter of situation. The *erg* country occupied by the Shambas is comparatively near the sea, and the people are in close touch with the

[1] Readers of the former *Bulletin of the American Geographical Society* will recall the map of the French Sahara accompanying the article by W. A. Cannon, "Recent Exploration in the Western Sahara," *Bull. Amer. Geogr. Soc.*, Vol. 46, 1914, pp. 81–99.

[2] E. F. Gautier: Déserts comparés, *Ann. de Géogr.*, Vol. 28, 1919, pp. 401–413.

Mediterranean world. Furthermore, they are Arabs having community of language and sentiment with all the Near East. The Tuaregs in their mountains in the heart of the continent are 1,000 kilometers from the Mediterranean, which they have never seen, though for centuries they have con-

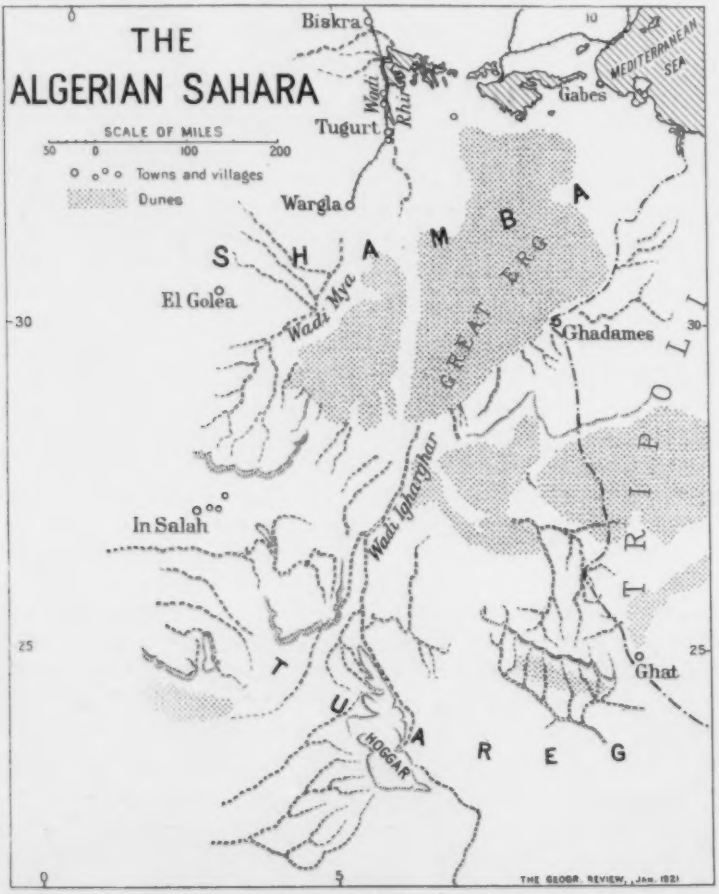


FIG. 1—Map of the eastern portion of the Algerian Sahara showing the oasis and the territories occupied by the Shambas and Tuaregs. Tugurt is the present terminus of the railway, the continuation to Wargla being projected. Scale 1 : 12,000,000.

trolled communications between it and the Sudan. The Sahara is theirs. They share its mystery. It has surrounded them with an aureole of romance bestowing on them a world-wide fame out of all proportion to their numerical importance. The name Tuareg is very generally known. It is to be found in every school geography associated with the name Sahara and used as the type of one great human group—the nomad. The Tuaregs are pure Berbers. They hate the Shambas; between them is perpetual and deadly

FIG. 2

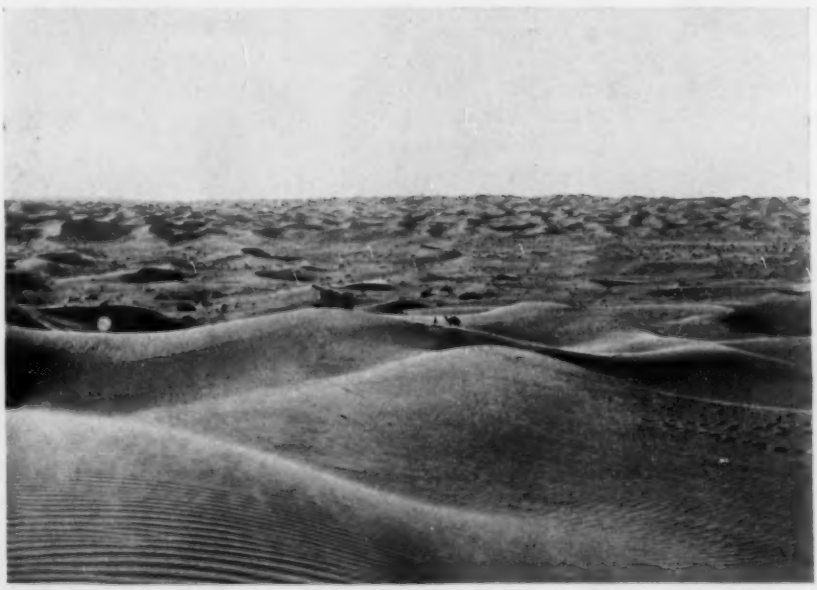


FIG. 3

FIG. 2—Pasturage of the wadi in the Algerian Sahara. The rocky ravines are characteristic of the region.
FIG. 3—Pasturage of the *erg* in the Algerian Sahara showing the scanty vegetation of the dunes.

enmity. Yet as human groups they are closely comparable. They live the same kind of life adapted to the same desert. No attempt will here be made to distinguish them.

The Oases

In the same region are the sedentary cultivators of the oases. A group of oases lies in the region of the great shotts between Biskra and Wargla. Its economic heart is the Wadi Rhir, a chaplet of palm gardens of which the chief is Tugurt, terminus of the railroad. Another group is that of Tidikelt of which only the eastern extremity with the capital In Salah is figured in the accompanying map. The great oases of Ghadames and Ghat (Rhat) belong politically to Tripoli; but they are not alien to our discussion, Ghat especially.

All these oases are of the same type. Under the shade of the date palms are the irrigated gardens. Whence comes the water? From the name Wadi Rhir and its geographical situation along the lower Igharghar one might believe that it was supplied with water by the wadi. But no flood of the Igharghar or the Wadi Mya ever approaches the Wadi Rhir by some hundred kilometers. The water is artesian, obtained by wells. At Tidikelt the arrangement for obtaining water is more complicated; there is in use a system of subterranean canals known to the Arabs as *foggera*. But without exception water supplying the oases comes from a depth and is secured by processes of surprising technical complexity.

In the Wadi Rhir native tradition attributes invention of the artesian wells to Dhu'l Karnain (literally signifying the two-horned). This is the name by which Alexander the Great is designated in the Koran, but it is Alexander in his rôle as the son of Jupiter Ammon (Ammon Ra) in which official capacity he was worshipped in Egypt by the side of the sun god. All tourists to Egypt have seen the chapel of Alexander in the temple of Luxor. The photograph, Figure 4B, is the representation of Ammon Ra from the temple of Karnak at Thebes. Figure 4A is Dhu'l Karnain from a rock carving near Figuig (on the Moroccan border of Algeria) one of the largest oases of the French Sahara. The two localities lie 3,000 kilometers apart at opposite ends of the Sahara. The resemblances of the carvings are striking. It is the same ram's head that is represented with the same detail—the Two-Horned god of the oasis and of irrigation.

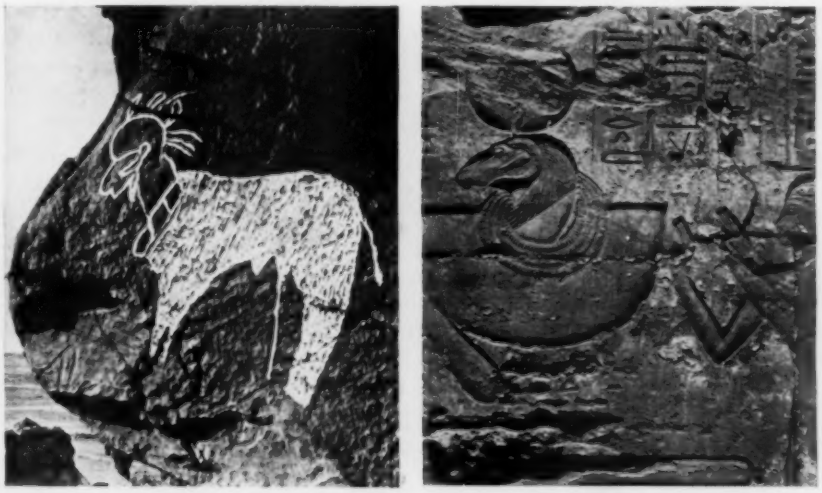
The technique of irrigation in the Algerian oases comes from Egypt, and it is interesting to note that traditions and native monuments preserve recognizable traces of their Egyptian origin. The technique of this old civilization is at strange variance with the barbarisms of those practicing it at the present day.

The oases dwellers are *Haratin*. The word comes from an Arab root signifying "to cultivate;" but it has lost its etymological sense and acquired an ethnic meaning, mulatto, and implies furthermore a mulatto type approaching the negro. The Haratin are a dark-skinned people. The

Tuaregs and Shambas are light-colored. Malaria, which is unknown on the pasturages, is on the contrary severe in the oases. Hereby may be explained the negroid aspect of the oasis dwellers, since for generation after generation there has been in operation a tendency to eliminate the more susceptible white element of the Haratin.

Relation Between Nomads and Oasis Dwellers

The sharp contrast that separates nomads and sedentary peoples does not mean, however, that these two human groups live independently of



A B

Fig. 4—A shows a rock carving near the oasis of Figuig which represents Dhu'l Karnain, the two-horned god of irrigation. B is a representation of Ammon Ra, the god of the oasis, carved on the wall of the Temple of Karnak at Thebes. The similarity of the figures suggests the identity of the two gods worshipped at the extremities of the Sahara.

each other. They are two parts of the same social mechanism, and its progress is dependent upon their collaboration. The life of the nomad is spent outside the oases, far from houses; with his family he dwells under the tent, almost, one might say, under the sky, in the pasture grounds and the paths leading to them. It is the life to his taste, his passionate preference. But from time to time he likes to descend on the oasis as the sailor likes to touch land. It is a psychological as well as an economic necessity. The nomad comes to the oasis to see men, to learn the news, to frequent the bazaars and the places of amusement.

It should be observed that the oases, even the smallest of some few hundred inhabitants, are towns, not villages. They possess the organs of urban life, as one readily appreciates at first sight. The architecture shows this, the storied houses with fine stairways, broad verandas opening on the

best exposure, and arcades. The building material is generally inferior. Stone structures are rare, almost everything is built of sun-dried clay. But in complexity of technique the methods of construction are a counterpart to the methods of irrigation, an inheritance of an old eastern civilization. Herodotus describing Babylon depicts the same contrast between the magnificence of the architecture and the inferiority of the material employed. Every oasis is a Babylon in miniature.

In this urban setting the life itself is distinctly urban. Each oasis has its market place, a sort of public promenade with booths. The places of amusement are indicative of the night life which is analogous to that of the low quarters of one of our ports.

There is also an economic side to the relations of the nomad with the oases. As regards food resources it is axiomatic that the nomad makes do what he has. There is the milk and flesh of his flocks, and he utilizes to an astonishing degree the wild plants of the desert. To cite but one instance, he gathers lolo, grains of a wild gramineous plant (Arabic drinn, *Aristida pungens*), for use as a flour, a side light on the domestication of wheat in the dawn of history. But such resources are yet insufficient. The nomad is tributary to the oasis for the greatest part of his vegetable diet, dates and cereals (wheat or millet).

On the other hand, he supplies the oases with indispensable products, in part of his own manufacture, rugs and fabrics woven by his women from the wool or hair of the flocks and herds or beautifully tanned leathers. He is also the intermediary bringing to the oases foreign goods, European cottons, for instance.

Subordination of the Sedentary Peoples of the Algerian Sahara

Such are the most fundamental relations between nomad and sedentary folk, not only in the Algerian Sahara but in all deserts and steppes. We shall now consider the peculiarities differentiating our region.

Here are two sets of people opposed to each other in every detail of their manner of life and even in their racial characteristics. Yet the social fabric is woven of their intimate relations. Our European societies are troubled by class strife, but the difference between our classes is far from being as profound as that which separates nomad and oasis dweller. How is equilibrium maintained? How are differences settled? Who polices and who governs? The answer is not far to seek.

Saharan society is of an anarchic and violent character. Familiar sobriquets for the region are *bled-el-khouf*, "country of fear," and *bled-es-sif*, "country of the sword." The oases are fortresses, walled and bristling with towers. Must one conclude that permanent warfare exists between the two peoples? Such is not the case in general. Each group fights amongst itself. The fortifications of the oases are primarily a protection against neighboring oases. A nomad tribe has for its hereditary enemy another

nomad tribe; there is a river of blood between Shambas and Tuaregs. Nomads and sedentary folk are too much complementary parts of one whole to engage in combat with each other. The sedentary folk would not think of offering resistance to the nomads. This fact will be appreciated if one reflects on the life of the latter. The desert climate, dry and severe, is very healthful. The nomad has the bodily characteristics of the white race. Save for certain rheumatic afflictions his strong frame preserves up to an advanced age an astonishing vigor. He passes his life from infancy to death wandering over the vast stretches of a region without security, where the distances between water may be as much as five or six days' forced march. He must travel fully equipped against attack, eating and drinking as little as possible. With empty stomach he must keep his head clear and his memory sure for topographic detail —under pain of death. To the dangers of nature are added those of his fellow man. Suspicion is bred in these monotonous solitudes. The nomad who encounters trace of human presence on the desert roads examines it with the inquietude of a Robinson Crusoe. The hard and dangerous life tempers body and soul, breeding a virile mind in the body of an athlete. This is the individual. In the tribes an instinctive disciplinary bond unites him to his fellows. Whether he guards the pasturage, escorts a caravan, or is actually taking part in a *razzia*, the nomad is a soldier every moment of his life. And the nomad tribe is a regiment.

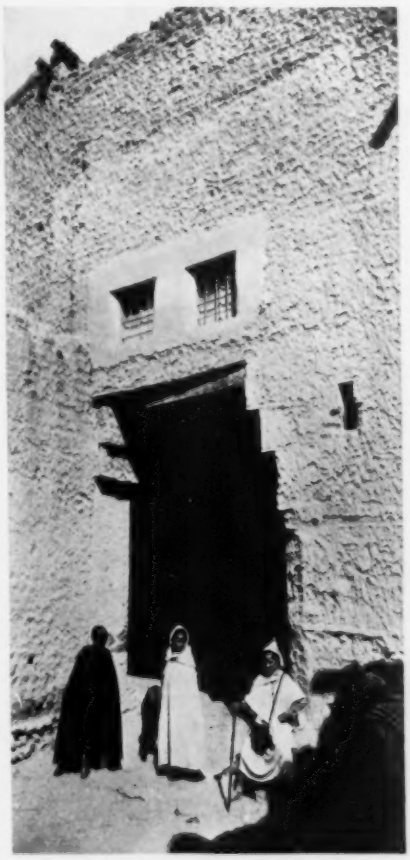


FIG. 5—A covered passageway in the oasis of Figuig (western Algeria). Their buildings and institutions show the distinctly urban character of the oases.

What chance have the poor Haratin against this disciplined horde? They are conscious of their racial inferiority, and they suffer a similar physical disability. Spending their entire life in the narrow horizon of the palm gardens they are stunted in body and mind. The Haratin have solved the problem by submission—they obey.

Each oasis has its nomad masters who at the same time are its pro-

tectors, its guard and its army—in consideration of regular tributes, irregularly collected by some abuse of power. It is under these conditions that the Tidikelt oases and Ghat pertain to the Tuaregs; Wargla and the Wadi Rhir to the Shambas.

The nomads are a superior caste comparable in a sense to the feudal lords. According to a Tuareg saying, "Shame enters the family with the plow."

It is worth while noting that in their social life the Tuaregs preserve traces of the matriarchate and in their utensils reminiscences of the later Stone Age. They are in fact splendid intelligent animals. In this respect they make a notable contrast with their serfs, the sedentary Haratin, who still retain vestiges of an old civilization, the oldest civilization of the world.

Tuaregs, Shambas, Haratin as Type Peoples

Tuaregs, Shambas, Haratin—they are all without importance from the numerical standpoint. Their exact numbers we do not know, but assuredly the Tuaregs could not put a thousand warriors in the field. Their interest for us is as human types of two great classes of peoples in French North Africa. They are extreme types, it is true, a little overdrawn, as it were, but so much the more helpful for the visualizing of certain basal concepts in human geography.

The Tuaregs belong to a group of tribes whose ancestors, under the name of Almoravides, conquered Morocco and Spain and filled with their glorious exploits the history of two centuries. The Shambas claim for their forefathers certain tribes of Hillalian Arabs whose traditional fame is still sung by wandering minstrels in the coffee-houses of Cairo. Setting out on their triumphant career in the eleventh century these tribes progressively invaded all Barbary, overthrowing empires and putting to the sword the Sultans of Tlemcen and Fez.

Not all the nomad tribes of French Africa can boast so brilliant a past or so romantic a present as Tuareg and Shamba, but all are of the warrior clan; all enjoy a feeling of social superiority and share a disdain for sedentary life. In current talk the nomad is referred to by a respectful paraphrase, "the people of powder" or "the people of the sword" or again "the people of the tent." The tent is as respectable as the house. To the Algerian nomad the towns are *el khnez*, "nauseating." The son of a noble family is designated *kheima kebira*, "son of the great tent." A nomad tribe ruined by losing its camels and consequently its mobility enters on sedentary life with rancor in its heart. It is the supreme humiliation, an irretrievable loss of caste. There is an expression of the great historian Ibn Khaldun on the degenerate descendants of ancient nomad tribes, "They have become so abased," says he, "that they pay the impost." The true nomad levies tribute and pockets it.

Not all the sedentary folk of French Africa are as abject as the Haratin of the Sahara. One may instance the M'zabites and the Kabyles. These peoples have held their own against the nomads and have preserved their independence but at heavy cost, hard pressed and beleaguered behind their fortress walls or in their high mountain valleys. Under the most favorable circumstances the sedentary peoples form a commercial or rural democracy, a populace of barefooted *fantassin* in contrast with the nomad cavaliers, the gentlemen of the sword, the least of whom has the aplomb and nonchalance of the aristocrat.

Such is the situation in Algeria and in all French North Africa. At first contact with the Egyptian social organization one realizes with surprise that on the banks of the Nile the situation is reversed.

The Egyptian Sahara

The Nile, whose valley constitutes Egypt proper, cuts the Egyptian Sahara into two parts, the Arabian and the Libyan deserts. It is the latter only that supports a human element. This is in the Egyptian oases, Kharga, Dakhla, Farafra, Baharia, Siwa.[3] Here dwell the peoples we shall compare with our Algerians.

The oases are entirely comparable the one with the other, Kharga or Dakhla with Wargla or Ghat. As regards their appearance, the importance of the palm groves, the numbers of inhabitants, the methods of securing water supply, they are alike. On the identity of the details of the last we have already spoken in discussing Dhu'l Karnain. Herodotus has described at length this string of like oases stretching from "Thebes in Egypt" to the "Pillars of Hercules" and "the Atlas," passing by the "Oasis of Ammon."[4]

The very name oasis is applied by Herodotus to the palm grove that we know today as Kharga. Everyone knows that this word "oasis," which has passed into most European languages, is a term of Egyptian origin. It should also be remarked that in the oasis of Siwa (the modern name for the oasis of Ammon) the language in use is a Berber dialect. As regards the oases, then, the similarity of the two Saharas, Algerian and Egyptian, has an ancient and firm foundation. But from every other point of view there is no accord between them.

As I have shown elsewhere[5] the two deserts are physically dissimilar. There is nothing in the Libyan Desert comparable with the system of Quaternary wadis in the French Sahara. Erosion has there developed a topography illustrated in the photograph (Fig. 7). The surface presented is that of a level plateau of low altitude from which rise occasional isolated buttes, the *Zeugen Berge* which Passarge has described from the Kalahari, a landscape that can only be explained as the result of prolonged eolian

[3] Only the Egyptian portion of the Libyan desert is discussed here; hence there is no mention of the interesting Kufra oases and the Senussi.—EDIT. NOTE.

[4] Herodotus, Bk. 4, Ch. 181.

[5] Article cited in footnote 2.

erosion acting through geological ages. The economic and human consequence is the absence of pasturages.

Another fact of first importance is the relative narrowness of the Egyptian Sahara. It is limited on the one side by the Red Sea, on the other by the enormous mass, completely arid and impenetrable, of the Libyan *erg*, an obstacle more repellent than the sea. Hence not only pasturage but

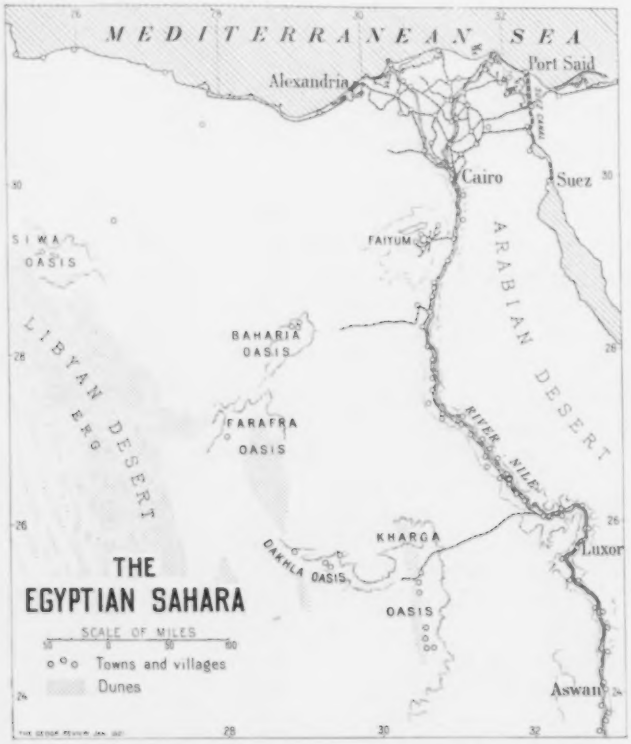


FIG. 6—Map of the Egyptian Sahara showing the oases of the Libyan Desert east of the great Libyan *erg*. Scale 1 : 9,000,000.

space is lacking the nomad. It must be said that Egypt itself is nothing more than a huge oasis, with that of Chaldea the finest on our earth. According to the last census (1911) Egypt had nearly 15,000,000 inhabitants. The presence in the heart of the Egyptian Sahara of such an agglomeration of sedentary peoples settles the question with the nomads.

THE BEDOUIN

The Egyptian Sahara has its Bedouins. Bedouin, the Arabic form of the word Bedawi, has passed into the European languages with the significance of nomad. The implication of the Bedawi is unflattering, and Bedouin

as we use it retains some of this derogatory sense—tatterdemalion. In Algeria it would never occur to any one to call the nomad "Bedawi." To do so would be ridiculous as well as dangerous. In Egypt the term does not offend anyone; not even the individual to whom it is applied.

The Bedouins are pastoral folk; they are the owners of camels and asses. But they pasture their flocks along the Nile under the control of the Administration. They are leaders of caravans, convoyers, commissaries. In

FIG. 7—A view of the Libyan Desert between Kharga and Dakhla. Prolonged eolian erosion has developed a level plateau region, from which rise isolated buttes.

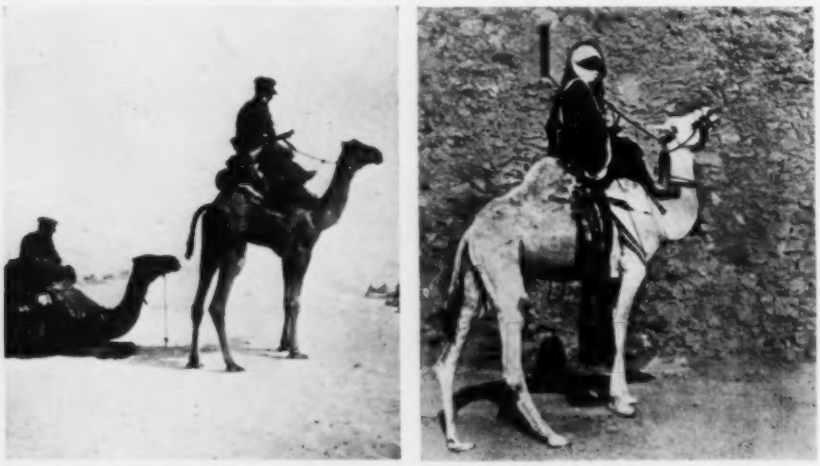
the last resort they tend to mendicancy; joining what, in French, is known as the *armée roulante*, in English as the army of loafers. Anyone who has visited the pyramids under the escort of an Egyptian mule driver has seen the Bedouin in the discharge of one of his functions. Obviously such people are not of the warrior caste of Tuareg and Shamba with their long tradition of glory and dominion.

In the oasis of Kharga the tourist admires the temple of Hibis;[6] it is a little jewel comparable in its finish with any building of the Nile basin. At Siwa still exist the ruins of the great temple of Ammon where all the ancient world came to worship. The Algerian oases have nothing comparable. The Egyptian oases bear the mark of the eternal mastery of the Pharaoh. In contrast to Algeria Egypt is a country where the sedentary has always dominated the nomad by overwhelming force.

[6] See the photograph, Fig. 6, accompanying the article by W. H. Hobbs "A Pilgrimage in Northeastern Africa, with Studies of Desert Conditions," *Geogr. Rev.*, Vol. 3, 1917, pp. 337–355.

Meharists and the Camel Corps

The difference between the two Saharas is interestingly reflected in a point of detail—the form of the saddles used on the dromedaries. In Egypt the dromedary is saddled with a *gabit*, a type of saddle used, under a variety of local names, in Nubia, around the Red Sea, and in Syria. With some unimportant modifications which we need not consider here it has been adopted by the Camel Corps of the British army. This saddle encases the hump extending back and fore; it is roomy and commodious but a



A B

Fig. 8—A, soldier of the Camel Corps of the British army. The saddle used encases the hump of the camel while a leather foot rest is placed on the animal's neck. B, a Tuareg. The saddle is very light and is placed in front of the hump. The bare feet of the rider rest on the camel's neck.

trifle heavy. The idea of attaching the saddle to the hump is so natural that one finds it everywhere in Algeria as in Egypt. But for their fleet camels the Tuaregs and Shambas employ a saddle constructed on a different principle. They call it the *rahla*, a term signifying traveler, nomad. Without the slightest change it is used as the regulation saddle in the *Compagnies françaises de meharistes*. The *rahla* is placed on the withers of the animal in front of the hump, which remains entirely free. It is equivalent to the front half of the Egyptian saddle. It is lower and cannot be mounted during pursuit. The neck of the animal needs protection from the chafing of the saddle, and the rider must lighten himself of the heavy part of his equipment. It is obviously adapted to the life of the Tuareg as we have described it, to the crossing of great waterless spaces.

Conclusion

We have attempted to analyze the conditions of human life and the relationship between the nomad and sedentary folk in two corners of

the Sahara. It is a little subject, clearly defined. Its conclusions may be generalized to extend over all Algeria and all Egypt from the present into the remote past.

Egypt is the cradle of our Christian civilization. The Egyptian still retains the characteristics of a people of ancient civilization, the subtle intellect, the hypercritical spirit. One recalls the descriptions of Alexandrian times left by the ancient writers and reflects on the bond between the growth of a great empire of sedentary peoples and their civilization with its foundation of order, wealth, and peaceful leisure.

Algeria with her neighbors Tunisia and Morocco is the home of the Berbers (Latin *Barbari*). The history of the Berbers is that of endless, indefinite warfare. This is the civilization that produced Hannibal, Masinissa, Jugurtha, the Fatimite generals who conquered Egypt, the Moors who pushed their way through Spain into southern France. There is a bond between this exclusively militaristic past and the present dominance of the nomads.

During the war Moslem soldiers in French uniform became familiar figures in France. They were natives of northern Africa, more particularly Algerians. Side by side were other native soldiers in the uniform of the British army. These were from India, however, not from Egypt. With her great population Egypt furnished scarcely a soldier to the Allies. Algeria and Tunisia furnished according to my estimate—no official figures are available—several hundred thousands. It is true, of course, that political conditions are different in the two areas and furthermore that during the last years of the war conscription was in effect in Algeria. But it is probably true to say that the Algerians would have been mortally offended to have been left out of the greatest war in history. Certainly the part they played has helped our mutual relations. In the last analysis it is the response of the warlike spirit, a spirit to which the Egyptian is stranger. The atavisms that these two peoples represent are the converse of each other.

HOKKAIDO, THE NORTHLAND OF JAPAN*

By Wellington D. Jones
University of Chicago

Hokkaido (Yezo), the northernmost of the four larger Japanese islands (Fig. 1) is of peculiar interest to geographers because it is so strikingly different from the rest of Japan. The Japan we commonly think of is a land of long, hot, rainy summers and mild, rainy winters, a land with rice and silk and tea as characteristic crops, a land with a dense population and a highly developed agriculture that utilizes to the utmost the cultivable area. In so far as Japan really counts for much in the world it is like this, but Hokkaido is different.

Topographic Similarities with the Main Island

In topography the 30,000 odd square miles of Hokkaido are much like the rest of Japan, with relatively much hill and mountain area and little lowland plain. The mountains are for the most part neither high nor rugged, and, though there are numerous fine volcanic cones, which add a striking element to the scenery, especially in the southwestern peninsula, much of the mountain area is non-volcanic. The highest mountain in the island is Nutapkaushpe, 7,691 feet above sea level. The most extensive plains are the lowlands of the Ishikari, Tokachi, Nemuro, Teshio, and Kushiro. Of these the Ishikari Plain is by far the largest and most important. The coastal lowlands are narrow and of relatively little importance for cultivation. Most of the streams are swift and of practically no use for navigation except for small boats and rafts. The water power possibilities of some of these streams are considerable.

Contrasts Between Hokkaido and the Rest of Japan

In other respects than topography, Hokkaido presents a marked contrast to the rest of Japan. Its population is sparse, and agriculture is in its infancy. Much of its cultivable area is covered with virgin forest. And yet, though at present undeveloped and unimportant, the possibilities of Hokkaido are of real significance, for its area constitutes one-fifth that of all Japan, and its resources in proportion to area are not far inferior to those of other parts of that country.

The name Hokkaido, meaning "Northland," calls attention to that feature of the physical environment in which this island differs most markedly from

* In July of 1916 the author of this article spent ten days in Hokkaido, traveling about the island with Professor H. Tanakadate of the College of Agriculture of the Imperial University of Tohoku. Observations made at that time are correlated in this article with facts obtained from the rather scanty literature on Hokkaido.

the rest of the archipelago. The climate of the main island—excluding the northern portion—is similar to that of the Carolinas, in the eastern part of the United States cotton belt, whereas the climate of Hokkaido is much like that of central Wisconsin or of New England.[1] Perhaps the most striking expression of the difference is the comparative unimportance of the great food staple of the East. In place of rice, which occupies the largest acreage in the southern islands, peas and beans constitute the chief crop in Hokkaido.

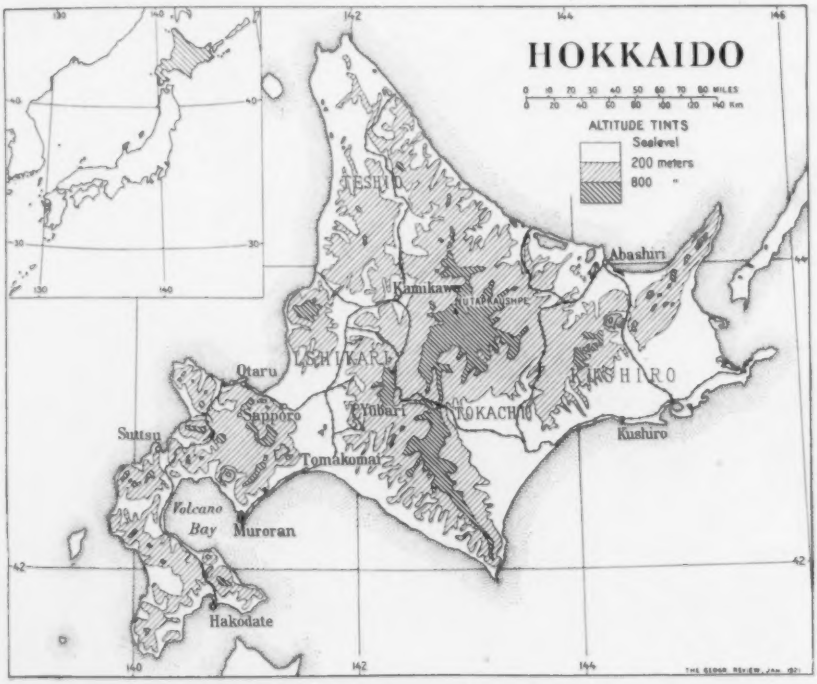


FIG. 1—Relief map of Hokkaido (scale 1 : 5,200,000) with inset showing relation to the rest of Japan.

Potatoes come second, three-fifths of the Japanese crop being grown in the northern island, where conditions are highly suitable. Cereals other than rice—oats, barley, maize, buckwheat, and millet—which are an important feature of the agriculture of the southern islands, are also of consequence in Hokkaido. But, whereas in the former they are grown as winter crops (except in the upland districts and except in the case of maize), in Hokkaido they are summer crops. The cooler summer climate of the northern island is again suggested in the growth of flax for fiber, a cultivation practically absent in other parts of Japan.

Of late years there has been much discussion about the possibilities of growing rice in Hokkaido. Until rather recently it was thought that rice

[1] See the note "The Climate of Japan" in the "Geographical Record" of this number of the *Review*.

would not mature in the short summers of the northern island. This idea was one of the causes of the reluctance of the Japanese to settle in Hokkaido and a partial explanation of the present sparse population there and the relatively undeveloped state of its resources. Within the last few years, however, it has been recognized that the interior lowlands enjoy warmer and longer summers than the coasts. In consequence there has been a rapid development of rice culture, particularly on the Ishikari Plain, so that at present there is a larger area in rice on the island than in any other cereal

FIG. 2

except oats. It seems improbable, however, that rice will become and remain the dominant crop in Hokkaido. A large part of the cultivable area of the island seems climatically unsuited to the crop, and, even in the sections where rice can be grown, other crops will probably prove more profitable, for the returns are smaller and less certain than farther south.

STATUS OF AGRICULTURE

Another striking difference between Hokkaido and the other parts of Japan lies in the relative importance of agriculture, a difference, however, that will tend gradually to disappear. At present not more than half of the arable land of Hokkaido is used, and large sections of potentially high-grade farm land still remain under the primeval forest. Just what proportion of the total area of the island can eventually be cultivated is not known; but, in view of the fact that the general character of the topography and the soil

is much like that of the other Japanese islands, 15 per cent is probably a safe estimate.

Cultivation in Hokkaido is much less intensive than in "Old Japan." The average size of farms in the north is 9½ acres, whereas in the southern islands it is 2½ acres. The presence in the fields of standing dead trees that have been killed by girdling, and of many stumps, also suggests the less intensive use of the land, as well as the recent date at which it was cleared for cultivation (Fig. 3).

TABLE I—AREA AND VALUE OF IMPORTANT CROPS IN HOKKAIDO, 1917

	AREA IN THOUSANDS OF CHO (cho = 2.45 acres)	VALUE IN MILLIONS OF YEN (yen = approx. 50 cents)
Total cultivated area	746.5	....
Beans and peas	171.7	23.6
Potatoes	76.1	13.3
Rice	63.9	17.2
Oats (1914)	63.2	4.2
Naked barley and barley (1918)	31.3	6.0
Millet	20.9	2.4
Maize	20.6	2.6
Flax	19.7	3.5
Buckwheat	18.4	1.5
Rapeseed	14.0	2.7
Wheat (1918)	10.7	2.0
Squashes	6.7	1.9
Radishes	5.5	1.4
Cabbages	2.9	1.0

From *Thirty-fourth Statistical Report of the Department of Agriculture and Commerce*, Japan.

The newness of the agricultural economy of Hokkaido is again reflected in the relatively greater importance of stock raising. In the old and densely settled parts of Japan there are few of the larger animals, and these are kept mostly for draft purposes. In Hokkaido the number of horses in proportion to the human population is comparatively large, and the raising of cattle for meat and dairy products has made a good start. In the sparsely populated northland there is a great need of draft animals to supplement human labor, while there is plenty of land available for grazing. Furthermore, the climate of Hokkaido is more favorable to the growth of forage plants than that of the southern islands, and some credit may be due also to the stimulus of American agricultural experts who were employed a generation ago to help in the development of the resources of the island. Yet, in spite of such favorable conditions, the number of cattle, while relatively superior to that of Old Japan, is very small. In the state of Wisconsin, where geographical conditions are much like those in Hokkaido, there was in 1914 an average

of somewhat more than one head of cattle per person, whereas in Hokkaido there was only about one head of cattle per 113 persons. The Japanese are not accustomed to eat meat and dairy products, and, until a better market for such products is developed either in Japan or in China, the number of cattle in Hokkaido probably will not nearly approach the number that the island could support.

The Fisheries

The first industry to develop in Hokkaido, and long the chief one, was fishing. The seas surrounding the island are rich in fish, and fishermen

Fig. 3—Field of beans in Hokkaido. The presence in the field of many stumps and standing dead trees suggests the less intensive use of the land.

from Honshiu early began to voyage northward in the summer season. Numerous coastal villages were established with a considerable population for the summer months of each year, but they were deserted during the long winter when their inhabitants returned south to a warmer clime. Gradually, however, certain of these villages, especially those on the southern and western coasts, became inhabited all the year round, and a little land was cultivated. Ultimately fishing gave place to agriculture and to the exploitation of the forest resources of the island. In spite of its relative decline, however, the fishing industry of Hokkaido today is more important than ever before, both as regards the number of people engaged in it, and the value of the products—50,000,000 yen (yen = 50 cents) average for 1917–1920. In fact, it seems clear that fishing will remain one of Hokkaido's chief industries.

Outstanding features of the industry are the large herring catch of the western coast, the cod catch of the Okhotsk Sea, and the annual run of salmon up the streams. The kelp harvest, which furnishes food sold both in Japan and in China, and the production of large quantities of fish manure

(by letting fish rot on the beaches) are also significant resources. Only a small part of the products of the Hokkaido fisheries is consumed on the island. The bulk of the catch is exported to the near-by markets in the densely populated parts of Japan and to China.

Numerous fishing villages along the coasts of Hokkaido add an extremely picturesque element to the naturally attractive landscape of the island. The typical village consists of a score or so of low, solidly built log houses, with roofs of rough-hewn shingles weighted down with many stones to withstand the gales. It possesses several sharp-prowed fishing boats that may be pulled up on the beach when not in use and that are launched for

FIG. 4—A terraced rice-field in Kiushiu, an example of the intensive agriculture of "Old Japan."

a trip by the united efforts of most of the inhabitants of the village. Not so picturesque or so conspicuous as these fishing villages, but of great importance as indicating the trend of things, is the number of scientific fish hatcheries and experiment stations.

FOREST AND MINERAL RESOURCES

Exploitation of the timber resources of Hokkaido did not become important until the 1890's or 1900's. Since that time, however, cutting has been rapid, and, though there remain considerable areas of forest untouched by the woodsman's ax, the not distant future will probably see a rapid decline in logging and lumbering. As usual in a new country logging methods are wasteful, taking only the best and leaving slashed and cut-over forests to disastrous fires, reminding one of early logging in Wisconsin or Michigan. The chief woods cut for lumber are oak and pine. The larger sawmills are near the mouths of the principal rivers, for most of the logs are driven down the streams, although now use is also being made of railroad transportation. The greater part of the lumber is exported either to the other Japanese islands or to the coast of China. Spruce is cut for use

in the pulp mills at Tomakomai (Fig. 5), on the southern coast of the island. These mills are said to be the largest of their kind in the Far East.

The forests of Hokkaido are of a very different type from those of the southern islands. The red pine and the broad-leaved evergreens, such as live oak and camphor which characterize the southern islands, are absent in Hokkaido, and in their place are the northern conifers and mixed hardwood and conifers. Beyond the difference in climate the relative proximity of Hokkaido to the Siberian mainland, whence certain tree species may

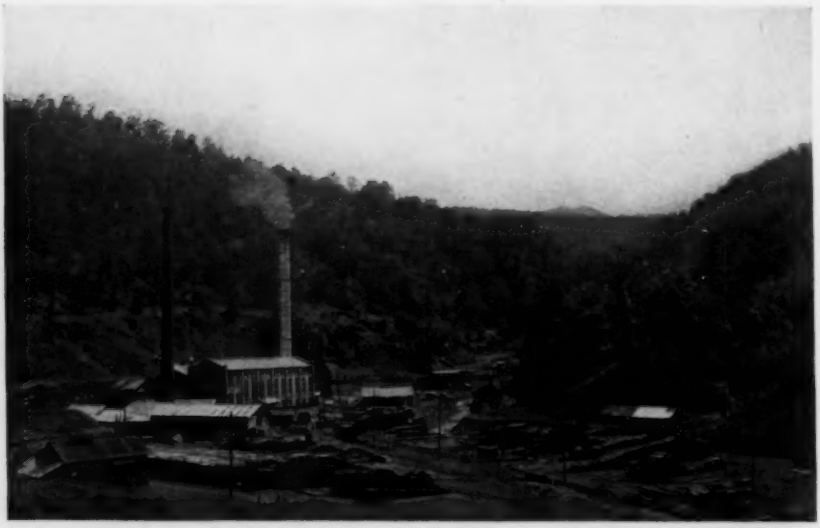


FIG. 5—A sawmill in Hokkaido. The logs are received and the lumber is shipped from the mill by rail.

have migrated, may be responsible in part for the difference in forest type between northern and southern Japan.

The coal of Hokkaido constitutes an important fraction of Japan's total coal resource. The deposits of northern Kiushiu are of somewhat greater magnitude than those of Hokkaido, but they are being exploited rapidly, so that the importance of the latter in the not distant future will be considerably greater than at present. The chief fields of the island are those of the Yūbari district, not far northeast of the port of Muroran. In this district mining is carried forward in vigorous fashion, with several thousand miners employed. The product is used on the railroads and in the steel mills at Muroran and sold as bunker coal. It is also exported to other parts of Japan and to the China coast. Of the 26,400,000 metric tons of coal produced in Japan in 1917, 3,700,000 tons were produced in Hokkaido.

The chief towns of Hokkaido are Hakodate on the southwestern peninsula, Otaru on the western coast, Muroran and Kushiro on the southern coast, and Sapporo, which is inland on the Ishikari Plain.

FIG. 6

FIG. 7

FIG. 6—The cool, foggy coast of Hokkaido. Note the sharp-prowed fishing boats which form the basis of the chief industry of the island.

FIG. 7—The coast of southern Kiushiu showing the fields of rice, the chief crop of the southern island.

The Seaports

Hakodate, with a population of about 100,000, is the oldest important town on the island. For a long time it was the chief port, and it is still a rival of Otaru, which now leads among the ports. As compared with Otaru, Hakodate has the advantage of being just across the straits from the main island. It is therefore the northern terminus of the ferry connecting the railroad system of Hokkaido with that of Honshiu, and it handles the mail and passengers to and from the mainland. Otaru, on the other hand, is nearer the largest productive area of the island, the Ishikari Plain (Fig. 2)

Fig. 8—The port of Kushiro at the mouth of the Kushiro River, showing the rafts of logs brought down the river to be sawed for export.

and so handles the bulk of the commerce of the island. Therefore, even though the harbor of Hakodate is excellent, with deep water and secure protection from storms, whereas that of Otaru has required considerable expenditure for deepening and for protective breakwaters, the importance of the latter port may nevertheless be expected to increase steadily. Otaru has growing exports of lumber, beans, coal, and fish and is the center of a thriving fishing industry. The situation of Otaru with reference to the coal fields of the islands and to the importation of iron ore from China or Manchuria would seem to favor the establishment of iron and steel mills somewhere in the vicinity.

Muroran, on the eastern side of Volcano Bay, has an excellent natural harbor and is the chief export port for Yūbari coal (see Fig. 1). The Tomakomai pulp mills also export through Muroran, and there is a timber trade of some importance. The iron and steel mills in the vicinity use coal from the Yūbari fields and ore from China and Korea. It has been suggested that Muroran may become a port of call and a coaling station for vessels trading between North America and eastern Siberia. Muroran has a promising future in trade and manufacturing, but it will probably never approach Otaru or Hakodate in importance.

Kushiro is the port of the southeastern coast. Logs rafted down the river are exported whole or sawn in mills near the town and exported as lumber. Sulphur and coal are also brought down the river from the interior and exported, together with quantities of fish. Kushiro has a tributary area that is less productive than that of Otaru, and it has a less favorable location with reference to trade with the mainland than Hakodate. As a port it will always be less important than either Otaru or Hakodate, its possibilities of development being perhaps on a par with those of Muroran. The harbor of Kushiro is of the river-mouth type and is only fair.

TABLE II—FOREIGN TRADE OF CERTAIN HOKKAIDO PORTS AND OF KOBE, 1917
(In millions of yen)

PORT	EXPORTS	IMPORTS
Kobe	479.8	530.1
Otaru	11.2	.3
Hakodate	6.4	.9
Muroran	2.3	1.6
Kushiro	1.1	....

From *Annual Return of the Foreign Trade of the Empire of Japan*, 1918, Part I.

All of these Hokkaido ports, even Otaru, are relatively insignificant as compared with the chief ports of Old Japan. The accompanying table of foreign trade statistics (Table II) indicates that in this respect, as in most other phases of economic development, the northern island is very new.

THE CAPITAL

Sapporo, the capital of Hokkaido, is the chief city of the Ishikari Plain. Its political importance undoubtedly has had much to do with its growth to nearly 97,000 in 1913, but its geographical position in the largest and most highly developed agricultural area in the island, is chiefly responsible for its development. Thus, while the statement that "the city was artificially established by the government" is in a sense true, the causes of the growth of the city are far from "artificial."

In appearance Sapporo is very different from the cities of Old Japan. The cold and snowy winters of the northland do not favor the thin-walled paper and bamboo structures that are typical of most of Japan. Because of the climate some other type of building must inevitably have been developed even had there not been another influence at work. This other influence was the group of American educators, engineers, and scientists who were employed by the Japanese government about the time Sapporo was founded and who introduced into Hokkaido the New England type of solid structures well adapted to cold and snowy winters. The result of the

combined influence of climatic exigency and foreign suggestion is a type of building that is a curious mixture of Japanese and American, with elements of both but looking like neither (Figs. 10, 11). Another alien feature of Sapporo is the gridiron plan of wide streets, strangely in contrast with the narrow, crooked lanes of the typical Japanese city. Sapporo has a growing university, an agricultural college, and an agricultural experiment station, and the city is the educational as well as the political center of Hokkaido.

The Immigration Movement

The foregoing sketch of the possibilities of Hokkaido naturally raises the question as to why they have not been utilized to a greater extent. Why has the population remained so sparse in contrast with overcrowded southern Japan? [2]

The reasons are several. For one thing, the cold and snowy winters in the north prove repellent. The people of Old Japan are not used to building warm houses, to keeping fires to warm their houses, and to wearing heavy clothing to protect themselves against low winter temperatures, and apparently they do not wish to settle where they must acquire such habits. This is a very real deterrent to settlement, as is attested by the repeated assertion of the fact by Japanese.

A second cause for the unwillingness of the Japanese to settle in Hokkaido was the fact that it was thought that rice could not be grown there. The staple crop in Old Japan is rice, and a plan of life with rice omitted is highly unattractive to the Japanese. Since it has been discovered that certain varieties of rice can be grown in parts of Hokkaido immigration to the island has been somewhat more attractive.

A third cause for the small immigration in Hokkaido has been and still is the existence of the rather hard and primitive conditions that belong to frontier communities. The clearing of the forest is a battle in itself. The long struggle which follows, in grubbing out the stumps from the fields, requires a quality not yet developed in most Japanese. The privations, both physical and social, which pioneers must endure, are numerous and stern and do not appeal to the men who have lived their lives in the highly organized communities of Honshiu, Kiushiu, or Shikoku.

Still another and somewhat less tangible cause for the Japanese not settling in Hokkaido is their love for the home district, where their ancestors have lived for generations. This is the more natural in view of the social organization, the religious belief, and the moral code of the Japanese.

In the 1880's the Japanese government began serious efforts to attract immigrants to Hokkaido and to exploit the resources of the island. American scientists, engineers, and educators were employed and for several years were actively engaged in establishing agricultural experiment stations,

[2] See the population maps in the article "The Distribution of People in Japan in 1913." by Mark Jefferson, *Geogr. Rev.*, Vol. 2, 1916, pp. 368–372.

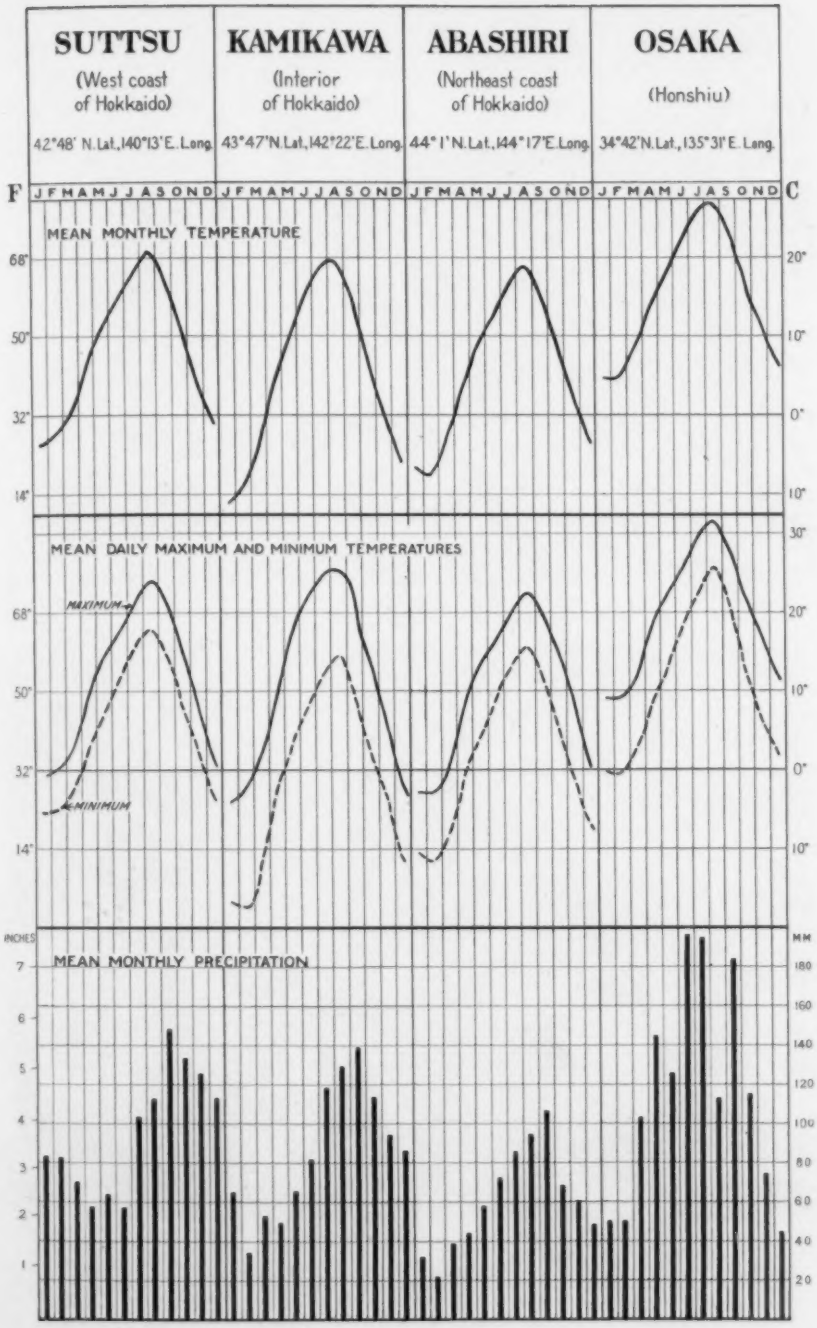


FIG. 9—Compare with the map of the Climatic Zones of Japan in the "Geographical Record."

FIG. 10

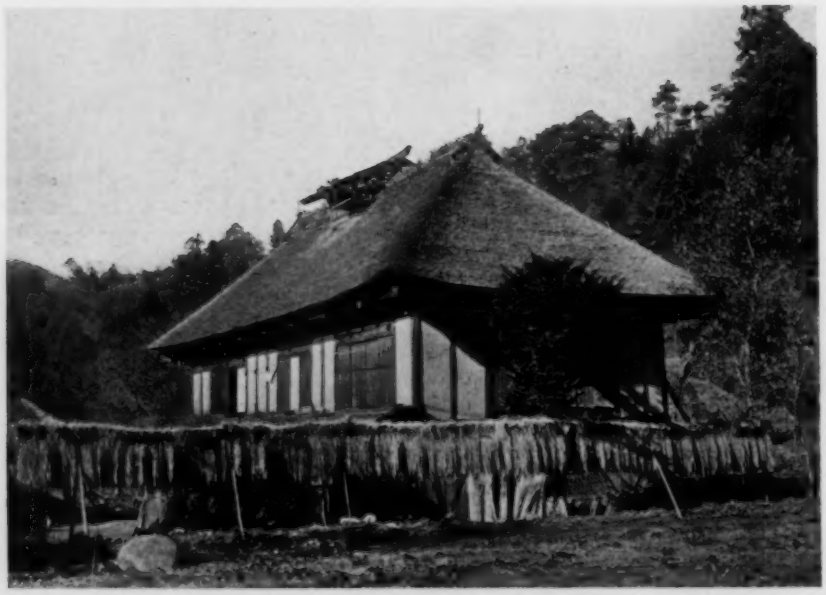


FIG. 11

FIG. 10—The substantial frame buildings of Hokkaido are the result of climatic conditions plus the foreign influence introduced by the group of American experts employed by the Japanese Government.

FIG. 11—A farmhouse in south central Honshiu. The thin-walled paper and bamboo buildings typical of Old Japan present a marked contrast to the solidly built structures shown in Fig. 10.

FIG. 12

FIG. 13

FIG. 12—Frontier conditions in Hokkaido. The mountains are covered with virgin forest while the isolated farmhouses are surrounded by partially cleared fields.

FIG. 13—A prosperous farm community in Old Japan with its carefully cultivated fields. The lower slopes of the hills are terraced for cultivation and the upper slopes are planted to forest.

making geological surveys, building railroads, and founding schools. The government offered various inducements to immigrants, such as cheap land, free transportation, and so on. The results, however, were disappointing, for immigrants did not come in as large numbers as had been hoped for, and many who did come returned later to their old homes in the south.[3] Gradually, however, the number of immigrants has increased, and in 1914 some 320,000 more people went to Hokkaido from other parts of Japan than left the island. In view of the fact that the total population of the island in 1914 was something less than two million, this was a notable increase. If this rate of addition be maintained the population-absorbing capacity of the island will probably be reached in a quarter of a century.

The influence of frontier conditions in Hokkaido on the habits and character of the immigrants from other parts of Japan is marked. The people have a certain kind of energy, a briskness of manner, and an upstanding independence of spirit that are much less noticeable in the inhabitants of the older and more highly organized communities of the southern islands. These differences are of a sort not unlike those between the people of the eastern part of the United States and those of the West. In the case of the United States the reflex influence of the frontier on the older communities was stimulating and helpful in the extreme. A similar reflex influence of Hokkaido upon the rest of Japan can be expected, although it is not likely to be as important as it was in the case of the United States, for in the United States the new regions were large and rich as compared with the old, whereas in Japan this is not the case.

Until Hokkaido becomes much more densely populated than now it will continue to be an increasingly important source of foodstuffs and raw material for manufacture for the industrial districts of southern central Japan. Its resources of agricultural land, forests, minerals, and fisheries are great enough to support a much larger population than it has at present and still leave a considerable surplus of products for export. Eventually, however, there will come a time when the island will have a population dense enough to require all or most of its products. But, however highly developed it becomes, Hokkaido never will be like the islands to the south. Fundamental differences in physical environment will be reflected inevitably and permanently in a different economic development, so that Hokkaido will always be the "Northland of Japan."

[3] See the article "Japanese Colonial Methods," by E. C. Semple, *Bull. Amer. Geogr. Soc.*, Vol. 45, 1913, pp. 255–275.

THE NATURAL REGIONS OF THE FRENCH ALPS

By Raoul Blanchard
University of Grenoble

The Alpine region is one of the parts of France of which the geographical study is furthest advanced. Completion of the geological map on the scale of 1:80,000, which event coincided with the foundation of the Institut de Géographie Alpine at the University of Grenoble, afforded the base for the prosecution of a wide range of geographical studies. Much has already been accomplished,[1] and thus it is now possible to present the major geographical features of the French Alps, an extensive region lying between the Lake of Geneva and the Côte d'Azur, a length of 300 kilometers, and the plains of the Rhone and the Italian frontier, a breadth of 150 kilometers. Here, however, in place of discussing the general features of this portion of the Alpine chain we shall endeavor to give some idea of the varied geographical aspects within the region itself.

The Fundamental Distinction between North and South

The outstanding feature of the regional classification of the French Alps is the contrast presented by the northern and southern portions of the chain. Insistence is laid upon this distinction, for too often one still meets the old division into Alps of Savoy, Dauphiné, and Provence, based on purely historical distinctions long since vanished.

The Climatic Boundary Line

The capital distinction between north and south rests in the climatic characteristics of the two sections, the one exposed to oceanic influences, the other falling within the Mediterranean régime. The Northern Alps, allowance being made for the effects of altitude, enjoys a climate essentially similar to that of the adjacent regions to the west and north—the plain of the Saône, the Central Plateau, the Jura. The temperature is rather low in winter, the summer is warm in spite of its humidity; rains are regularly distributed and abundant, with maxima in the summer and autumn. It may be described as the "maize" type of climate, and in fact cultivation of this cereal along with the mulberry is common in all the valleys of the Northern Alps where the altitude does not exceed 500 meters. The distinctive feature of the climate is the abundant precipitation, both rain and snow, in virtue of the relief and exposure. On the western side

[1] Published for the most part in the *Recueil des Travaux de l'Institut de Géographie Alpine* (1913–1919) and its successor the *Revue de Géographie Alpine de Grenoble* (1920–).

of the massif of Chartreuse the annual precipitation amounts to between 3 and 4 meters; 9 to 10 meters of snow falls annually at Tour in the valley of Chamonix (altitude 1,400 meters).

On the contrary the southern Alps present—and in a degree little affected by altitude—all the climatic features of the Mediterranean region, in particular the characteristic drought. Temperature is higher; evaporation is more active. The northern winds, of which the mistral is typical, bring no precipitation but on the contrary are avid absorbers of moisture. Rains are rare and correspondingly violent. There are two distinct dry seasons, that of winter and more markedly that of summer, the latter lasting six months. Snows also are scant. On the other hand, the autumn rains fall in tempestuous showers that score the land and swell the torrents with startling suddenness.

Structural Differences

To this climatic contrast must be added the structural differences between the two parts of the chain. In the south the trend of the relief is complicated by the effects of two directions of folding, the one Pyrenean, the other Alpine. In the north the arrangement of folds is simple and regular. As is well known, besides simple folding and faulting a large part of the Alpine structure as a whole has been accomplished by horizontal displacement, especially in the central and eastern Alps. Overthrusting is far less important in the French Alps,[2] but even here there is a significant distinction between north and south in this regard. Although the masses of overthrust material (*charriage*) become more abundant as one proceeds to the northeast, in the northern section of the French Alps west of the central massifs they occur only in the little region of Chablais. In the south they occupy an extensive area in the upper Durance basin.

Furthermore, there is dissimilarity between north and south in the nature of the rocks. The south exhibits to a far greater degree than the north a complex of hard and soft rocks.

Effects of Climatic and Structural Differences

These differences of climate and structure are reflected in all other geographical phenomena. While the relief of the northern section is simple, harmonious, and already in a well-advanced stage, that of the south is irregular and disordered. The highest summits of the southern section fall far short of those of the north, yet the mean elevation is not greatly inferior and penetration is far less easy. Glaciers are naturally less well-developed; the extent is only about one-tenth that of the northern section, and the streams are characterized by irregularity and paucity of discharge

[2] See Raoul Blanchard: La structure des Alpes, *Recueil des Trav. de l'Inst. de Géogr. Alpine*, Vol. 3, 1915, pp. 163–227. Grenoble.

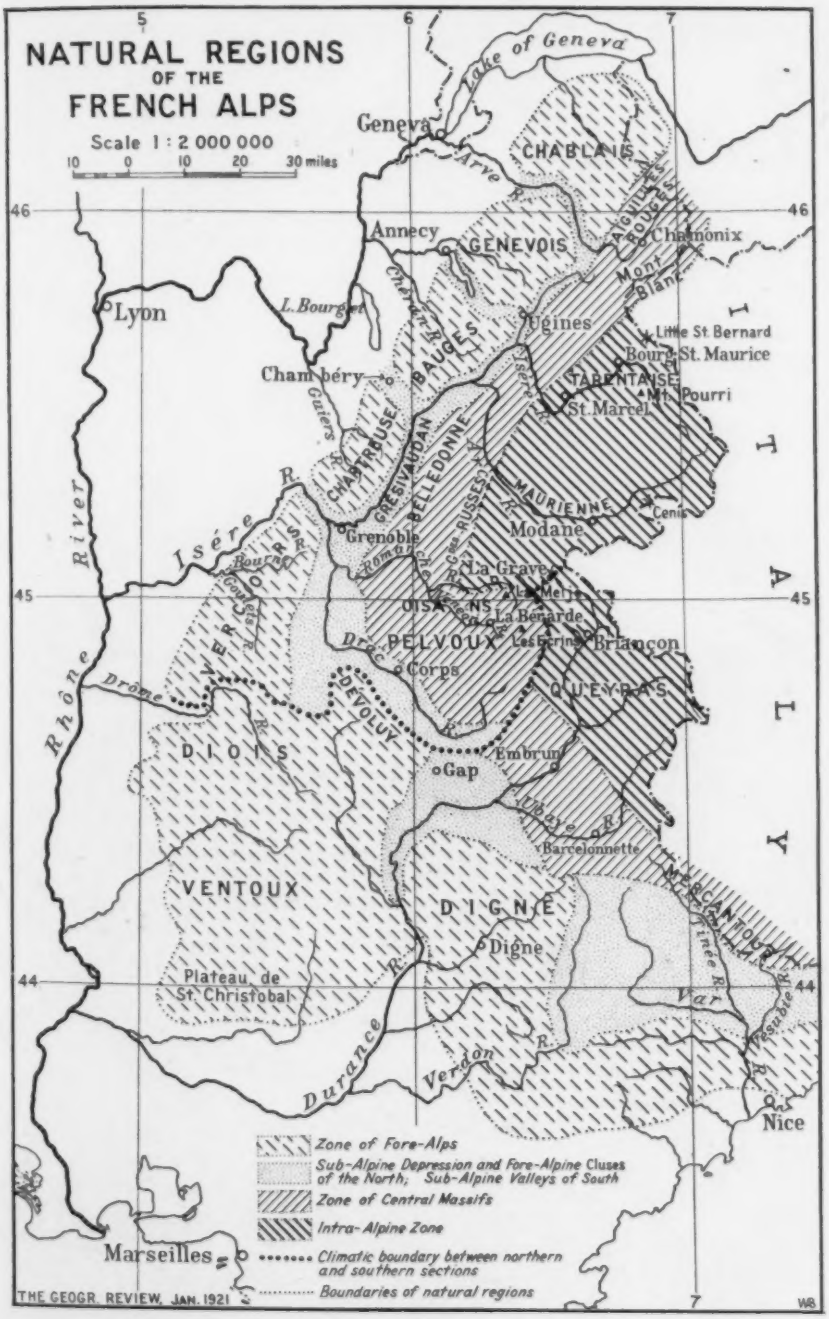

NATURAL REGIONS
OF THE
FRENCH ALPS
Scale 1 : 2 000 000
10 0 10 20 30 miles
Lake of Geneva
Geneva
Arve R.
CHABLAIS
Aiguilles Rouges
Chamonix
Mont Blanc
Annecy
GENEVOIS
Lyon
L. Bourget
Chambéry
Chartreuse R.
BAUGES
Ugines
Little St Bernard
Bourg St. Maurice
TARENTAISE
Mt. Pourri
St. Marcel
Guiers R.
CHARTREUSE
GRESIVAUDAN
BELLEDONNE
Isère R.
MAURIENNE
Cenis
Modane
Grenoble
Romanche R.
La Grave
Rhône River
Bourne R.
Vercors
OISANS
La Bérarde
PELVOUX
Briançon
Drac R.
Corps
Drôme R.
DEVOLUY
QUEYRAS
DIOIS
Gap
Embrun
Ubaye R.
Barcelonnette
VENTOUX
DIGNE
Digne
MERCANTOUR
Plateau de St. Christobal
Var R.
Verdon R.
Durance R.
Vesubie R.
Nice
ITALY
Zone of Fore-Alps
Sub-Alpine Depression and Fore-Alpine Cluses of the North; Sub-Alpine Valleys of South
Zone of Central Massifs
Intra-Alpine Zone
Climatic boundary between northern and southern sections
Boundaries of natural regions
Marseilles
THE GEOGR. REVIEW, JAN. 1921
WB

FIG. 1

where those of the north have an abundant and steady flow admirably adapted to industrial purposes.

Under the influence of copious and regular rains the vegetation of the Northern Alps is profuse and fresh. Below the 2,000-meter line forest clothes the slopes, tending to occupy all spaces undisputed by man. Above, to the limit of vegetation at the 2,500-meter line, extend the alpine meadows. In the south the struggle for life is harder. The disseminated vegetation has a meager aspect. In the characteristic forms of *garrigue* and *maquis* are signs of adaptation to drought. On the slopes grass frequently alternates with bare rock.

Human life reflects these conditions. The north is a region of flourishing agriculture based especially on cattle raising. This is the cow country. The drier south is the great sheep domain. In the south irrigation is necessary: insufficiency of water limits cultivation on the characteristically ravined slopes. The length and difficulty of routes across the chaotic mountains restricts traffic, which on the contrary circulates freely along the ample valleys of the north. The same circumstances in combination with the great hydro-electric resources favor industry in the north as against the south. The sum total of influences is reflected in the population densities—19 people per square kilometer in the south, 55 per square kilometer (including the large towns) in the north.[3]

The dividing line between north and south is very clear. It is the remarkable climatic boundary that runs from the Drôme to the Durance by the passes and crests forming the southern boundary of the Isère basin.

The Northern Alps

Simplicity of structure and relief and the resultant well-developed hydrographic system permit the distinction of the northern Alps into four groups of natural regions parallel to the arc of the chain—the Fore-Alps, the Sub-Alpine Depression, the Central Massifs, and the Intra-Alpine Zone.

The Northern Fore-Alps

In this region are included the outlying massifs that owe their origin to folding in place in front of the central massifs, exception being made of Chablais where the folds of local origin are buried under masses that have been overthrust from the southeast. The distinctive features of the Northern Fore-Alps are the more clearly revealed towards the west where the massifs overlook the exterior plains and towards the east where they tower still more boldly over the Sub-Alpine Depression. The regular folds of the well-known Jura type, formed in alternate limestones and marls, have been modeled by erosion into lines of white cliffs and longitudinal valleys. The crest lines show none of the typical Alpine forms—no needles,

[3] See J. Robert: La densité de population des Alpes françaises d'après le dénombrement de 1911, *Rev. de Géogr. Alpine*, Vol. 8, 1920, pp. 5–124; noted in the *Geogr. Rev.*, Vol. 10, 1920, p. 345.

no isolated summits—but appear as veritable fortress walls, bastions, high platforms terminated by rude precipices, across which the streams have cut their way by deep gorges, the famous *cluses* of Chéran, the two Guiers, the Bourne, and the Goulets.

Although not greatly elevated (the summits rarely surpass 2,000 meters), these westward-lying heights get the full benefit of exposure to the humid westerly winds and receive the heavy rains and snows to which they owe their wealth of vegetation. This is indeed the country of beautiful meadows and splendid forests (beech and fir), the domain of grass and tree. There

FIG. 2—In the Northern Fore-Alps. The limestone cliffs of Mont Pennay in the Bauges massif

is little land under cultivation, and even that is steadily diminishing before the meadows. Cattle raising has become almost the exclusive interest of the population, exception being made of the exploitation of the forests.

But the interiors of these rich mountain lands are not easy of access. Despite the marvelous defiles of the *cluses* few railroads approach them. Industrial activity is confined to the periphery, and the population of the interior remains sparse, declining from the north to the south as the means of communication become poorer. The average density of the region is 27 per square kilometer, ranging from 39 in Chablais to 13 in Vercors.

The continuity of the Fore-Alps is broken by great valleys which cross it. Some, such as the Arve and the Isère, are occupied by streams draining to the Rhone. Others, as the *cluses* of Annecy and Chambéry, which preserve traces of former glacial erosion in the still lake-filled depressions

of Bourget and Annecy, are today streamless. Broad and deep, these valleys serve as mountain gateways. Commanding entrance and exit here are the important Alpine towns, Annecy, Chambéry, Grenoble. Ease of communications, industrial development, richness and variety of agri-

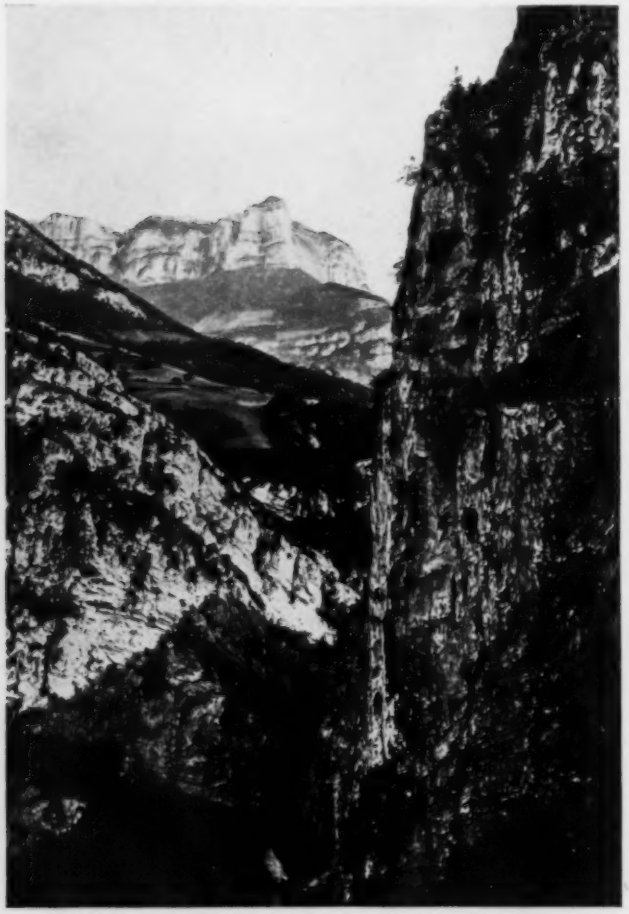


FIG. 3—Gorges in the Chartreuse massif, Northern Fore-Alps.

cultural resources distinguish the great *cluses* from the mountains of the Fore-Alps in which they are cut. They may indeed be considered as prolongations of the Sub-Alpine Depression.

THE SUB-ALPINE DEPRESSION

Separating the Fore-Alps from the Central Massifs is a zone of much lower altitude. This Sub-Alpine Depression is a monoclinal trench eroded

by riverine and glacial action in the band of soft schists, lying west of the crystalline massifs. It is constituted by a series of valleys of capture by which all the streams of the Northern Alps save the Arve have been brought into the trunk system of the Isère. At Grenoble, where the Isère crosses the Fore-Alps, the depression is very deep (altitude 200 meters). Width and height however vary greatly: in places the floor of the depression attains an elevation of 1,000 meters.

The Sub-Alpine Depression is a varied region. It includes true plains, broad and low as that of Grésivaudan, plateaus, and elevated basins. But, whatever the altitude attained, it is always enclosed by sheltering mountains much more elevated. Everywhere it offers man a fertile soil, the product of the disintegration of the soft rocks enriched by river alluvium and glacial deposition. The agriculture here practiced is of the type of the extra-Alpine plains, but under these exceptional conditions of soil fertility and shelter it offers possibilities of greater diversity and successful prosecution. The vine perhaps claims first place, followed by other fruits. On the alluvial soils cereals yield abundantly, and tobacco and beets flourish. Industry also finds conditions favorable. There is a plentiful labor supply which has, for instance, permitted the development of the famous glove manufactory of Grenoble. Local raw materials, to which may be added the fuel resources (anthracite) of the near-by Central Massifs, have led to the establishment of paper and pasteboard mills and the manufacture of lime and cement. The most notable feature of industry, however, is the use of hydro-electric power. The "white coal" industry began here in 1868; the technique of transmission was mastered in 1884; and today the great factories of the Sub-Alpine Depression, including that of Ugines which employs 3,000 hands, utilize 230,000 horse power.[4]

The depression is the vital artery of the French Alps. All the major routes of communication run for shorter or longer parts of their courses along the depression, which is strung from end to end with a succession of big villages, towns, and little market centers. The density of population averages 54 per square kilometer and in Grésivaudan, the most densely populated part of the French Alps, rises to 196.

The Central Massifs

There is a profound contrast between the broad trough described above and the barrier of high massifs which dominate it to the east, mighty mountains including the highest summits of the chain, Mont Blanc (4,810 meters) and Les Ecrins (4,103 meters). These massifs represent ancient Hercynian masses buried under more recent sediments and uplifted by the mountain-building movements of Tertiary time into a broken arc. Here the arrangement is in two parallel lines, the one (exterior) extending

[4] For details see R. Blanchard: L'industrie de la houille blanche dans les Alpes françaises, *Ann. de Géogr.*, Vol. 26, 1917, pp. 15–41.

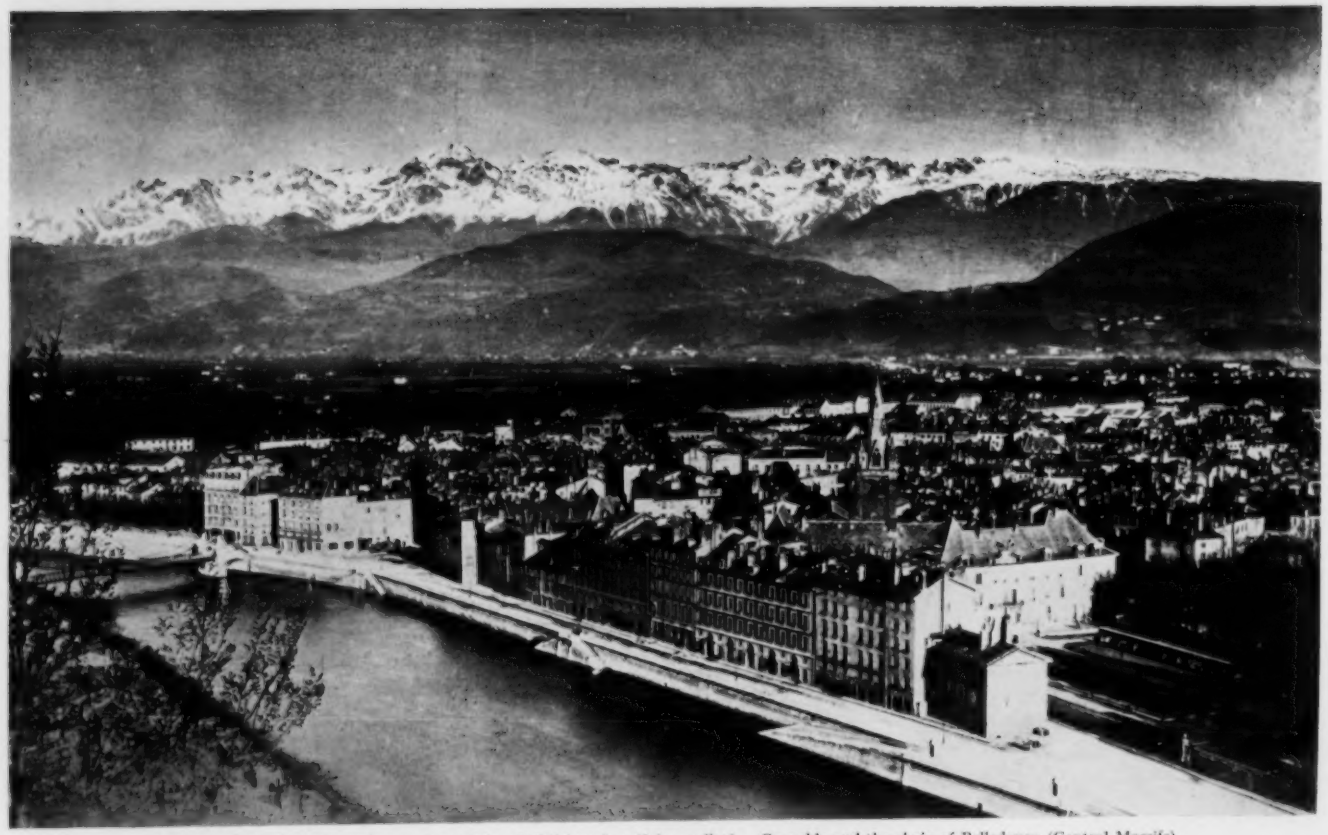


FIG. 4—In the Sub-Alpine Depression, plain of Grésivaudan (Isère valley). Grenoble and the chain of Belledonne (Central Massifs).

FIG. 5—In the Sub-Alpine Depression. Valley of the Drac at Corps. In the background L'Obiou, a summit of the Fore-Alps (massif of Dévoluy).

from Aiguilles-Rouges to Belledonne, the other (to the east) from Mont Blanc to Grandes-Rousses, the two meeting in the great crystalline mass of Pelvoux. The effect of pressure against these resistant cores has been to lift them to a great elevation, and they still maintain a great comparative height because of the effective resistance to weathering offered by the hard rock. Here are the usual forms seen in lofty mountains exposed to the active forces of erosion, subaerial and glacial,—a mass of serrated peaks, needles, and teeth, rising above the cirques and the troughlike valleys. Here one finds over half the glaciers of the French Alps (about 260 square kilometers) and among them the great glaciers of Mont Blanc, the Boissons, the Mer de Glace, descending to a level of nearly 1,100 meters and bringing the exotic splendor of their blue *séracs* into the midst of the verdure of forest and meadow.

This lofty zone, of which large areas are covered permanently or seasonally with ice and snow, is a barrier to man. It is of course a region of predilection to the alpinist, and in the recesses of the proud massifs are situated some of the chief tourist centers of the Alps, such as Chamonix and La Bérarde. But otherwise its resources are few. They are limited to such agricultural possibilities as are offered by the synclinal valleys pinched between the crystalline masses, the valley of Chamonix, the plain of Oisans, or to the exploitation of the forests and the pastures in the less elevated zone below the massif of Mont Blanc. The hydro-electric power from the streams is used only in the Sub-Alpine Depression or in the Intra-Alpine Zone. These massifs then are primarily a zone of isolation. Fortunately, however, the barrier is crossed by three passageways, the gorges cut by the Upper Isère, the Arc, and the Romanche, which though narrow afford practicable communication between the Sub-Alpine Depression and the Intra-Alpine Zone.

The Intra-Alpine Zone

Behind the central massifs are piled the great overthrust sheets so characteristic a feature of the Swiss Alps, formidable thicknesses of sediments from the depths of the Alpine geosyncline, gneisses and lustrous schists (phyllites), and towards the west sediments of more varied character and an origin less deep, sandstones, schists, limestones. Naturally the relief modeled upon these sheets is greatly varied in form and altitude. There are deep-sunk basins and steep-walled valleys, massive mountains and peaks most marvelously chiseled. In Tarentaise the floor of the Isère valley is only 800 meters above sea level at Bourg St. Maurice near the frontier, and the graceful pyramid of Mont Pourri overlooking it attains an altitude of 3,788 meters. In Oisans the Meije rises 2,500 meters above the basin of La Grave.

The contrasts between other geographical features is correspondingly accentuated. The closely sheltered basins are less well-watered. Not one receives as much as a meter of precipitation a year. The forest is less

extensive than in the western region and of a different facies: the larch, a tree thriving in drier and sunnier areas, replacing the spruce and fir. The alpine meadows occupy a more elevated zone than in the Central Massifs, and cultivation likewise climbs higher, here and there attaining a height of 2,000 meters. The lower slopes of the deep, sheltered valleys are limited to the more delicate cultivations: the vine is found at elevations of 1,000 meters. Thus the inhabitant of the zone finds highly varied agricultural resources—vineyards and orchards, fields and forests, alpine

FIG. 6—Glacial trough of Vénéon, massif of Pelvoux.

pastures—at his disposition, and he makes use of them all by becoming a veritable nomad. In the winter even as well as in the fine season he is on the move passing from stage to stage: when he is no longer needed in the vineyards he occupies an alpine châlet in the zone of high pastures; when cold drives him thence he returns by successive steps to the valley.

As in the Sub-Alpine Depression industry is correspondingly developed. The Intra-Alpine Zone utilizes 570,000 horse power, about half the hydro-electric force furnished by the French Alps. The greater part is employed in electro-chemical and electro-metallurgical industries. Similarly, ease of communication is another favorable factor. The zone is the highway of Franco-Italian traffic which makes use of the passes of the Little St. Bernard and Mont Cenis and of the Paris-Turin railway.

Of old these various favoring circumstances led to a fairly considerable density of population and promoted the growth of little independent

civilizations that were in effect mountain republics (Maurienne, Tarentaise, Oisans) comparable to the forest cantons of Switzerland. Today the population density of lower Tarentaise is 44 per square kilometer, of lower Maurienne, 50; and the civilization of this high mountain region remains the most distinctive of the four natural regions of the French Alps.

The Southern Alps

Broader, and of more complex structure, the southern section of the French Alps presents a much more confused relief than that of the north, and the natural regions are correspondingly less clearly defined. A continuation of the four regions of the north can indeed be recognized, but their physiognomy is modified and the relations between them are different. While the Fore-Alps here occupies a relatively enormous area, the Intra-Alpine Zone is reduced, tapering out to the verge of disappearance. Between the Central Massifs are intercalated mountain ranges of dissimilar character; the Sub-Alpine Depression gives place to another regional type—the Sub-Alpine valley.

The Southern Fore-Alps

South of Vercors the folded Fore-Alps become increasingly broad at the expense of the Central Massifs which bend sharply towards the southeast. Instead of the simple folding of the northern Fore-Alps, we have here sequences of short folds pertaining to two systems of different age and direction. Furthermore, the constituent rocks are less homogeneous than those of the north and consequently have suffered more under diastrophism and subsequent weathering. Where the black marls and yellow clays predominate and the massive white limestones are rare, erosion has powerfully modified the original relief, excavating a series of little basins from which the waters drain by picturesque defiles.

The Southern Fore-Alps are much drier, a feature specially marked in the valleys. At the bottoms of the basins are irrigated fields, watered meadows, and vineyards; on the suitably exposed slopes the more delicate fruit trees. Under shelter the olive is cultivated in a zone extending right across the region. The upper slopes, however, support only a meager brushwood including characteristic aromatic plants and affording pasturage for sheep and goats. These massifs are the poorest and least populated part of the Alps. The average density is 16, falling to 12 in the massif of Digne.

Furthermore, in spite of their moderate altitude these massifs constitute a true wall isolating the southern Alps from the exterior. No ample valleys give access across them as is the case in the north. The Verdon, for instance, issues from the Fore-Alps by a canyon so narrow that it has been followed by but a few explorers and by these only at the risk of life. The

FIG. 7

FIG. 8

FIG. 7—Intra-Alpine Zone of the North. The station of Modane (Maurienne) close to the Italian frontier.
FIG. 8—In the Intra-Alpine Zone of the North, the *verrou* of St. Marcel (Tarentaise). Hydro-electric establishment in the foreground.

Durance alone describes a valley broad enough to be termed a plain, and it is by this open highway that all communication is effected between Provence and the Alps. With its hydro-electric establishments and its flourishing agriculture the Durance might rather be regarded as the equivalent of the Sub-Alpine Depression of the north.

The Sub-Alpine Valleys of the South

The Sub-Alpine Depression disappears simultaneously with the break in the Central Massifs, that is on the southern border of Pelvoux. In place of that long corridor serving all the passages of the mountain are a series of transverse compartments terminating most frequently in a *cul-de-sac*. Only in the region of Gap, where a domal structure is developed and where the softness of the rocks has facilitated erosion, is there a depression of any continuity; and this peripheral depression is, as it were, a turntable of communications in the southern Alps. But the valleys of the Verdon, the Var, the Tinée, and the Vésubie are separated from one another giving only onto very elevated passes. Few parts of the Alps are more isolated. a striking contrast with the corresponding region of the north.

On the other hand, these valleys are much better watered than the Fore-Alps. On the slopes are fine forests, larch and pine mingled with spruce; the lower slopes above the olive groves are adorned with superb chestnuts. The raising of cattle as well as sheep is carried on. The water courses are well fed, and industry has commenced. The works under way will provide for 150,000 horse power in the near future, destined principally for the Côte d'Azur. The favorable features increase as approach is made to the Mediterranean. The density of population, only 10 per square kilometer along the Verdon, rises to 27 in the valley of the Vésubie.

The Central Massifs

Further contrasts with the Northern Alps appear in the southern continuation of the zone of Central Massifs. The Hercynian masses which constitute these massifs disappear south of Pelvoux to reappear to the southeast in the massif of Mercantour which with its bold peaks, cirques, and little glaciers recalls the great ranges of the north. The hiatus between Pelvoux and Mercantour is filled in by a great mass of Flysch sediments, beds of sandstones and schists inclined towards the west and supporting here and there limestone fragments that give a characteristic contour to these mountain summits. Yet contrariwise to the north these mountains do not constitute a barrier. Across the little-resistant surface the upper Durance and the Ubaye have worn down the Flysch to the underlying very soft black marls and have excavated basins therein, as those of Embrum and Barcelonnette, sites for settlement and passageways permitting access to the Intra-Alpine Zone.

FIG. 9

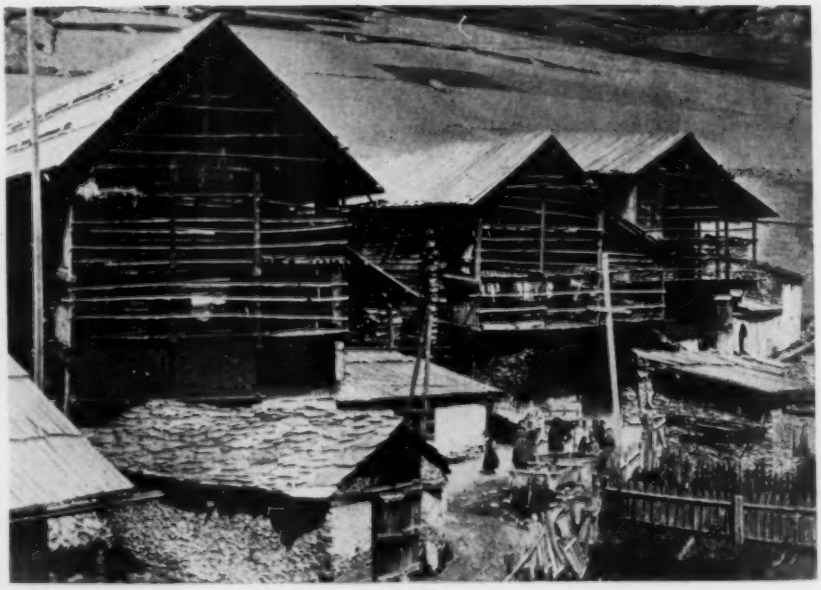


FIG. 10

FIG. 9—In the Southern Fore-Alps. Gorge in Diois.
FIG. 10—House types at Queyras. Intra-Alpine Zone of the South. Altitude 2,000 meters.

FIG. 11

FIG. 12

FIG. 11—In the Sub-Alpine Valleys of the South. Entrance to the gorges of the Verdon.
FIG. 12—In the Sub-Alpine Valleys of the South. The lower Tinée.

FIG. 13

FIG. 14

FIG. 13—In the Central Massifs of the South. A typical basin in the Flysch of Embrunais.
FIG. 14—In the Central Massifs of the South. A basin in the Flysch (soft black marls) of Ubaye.

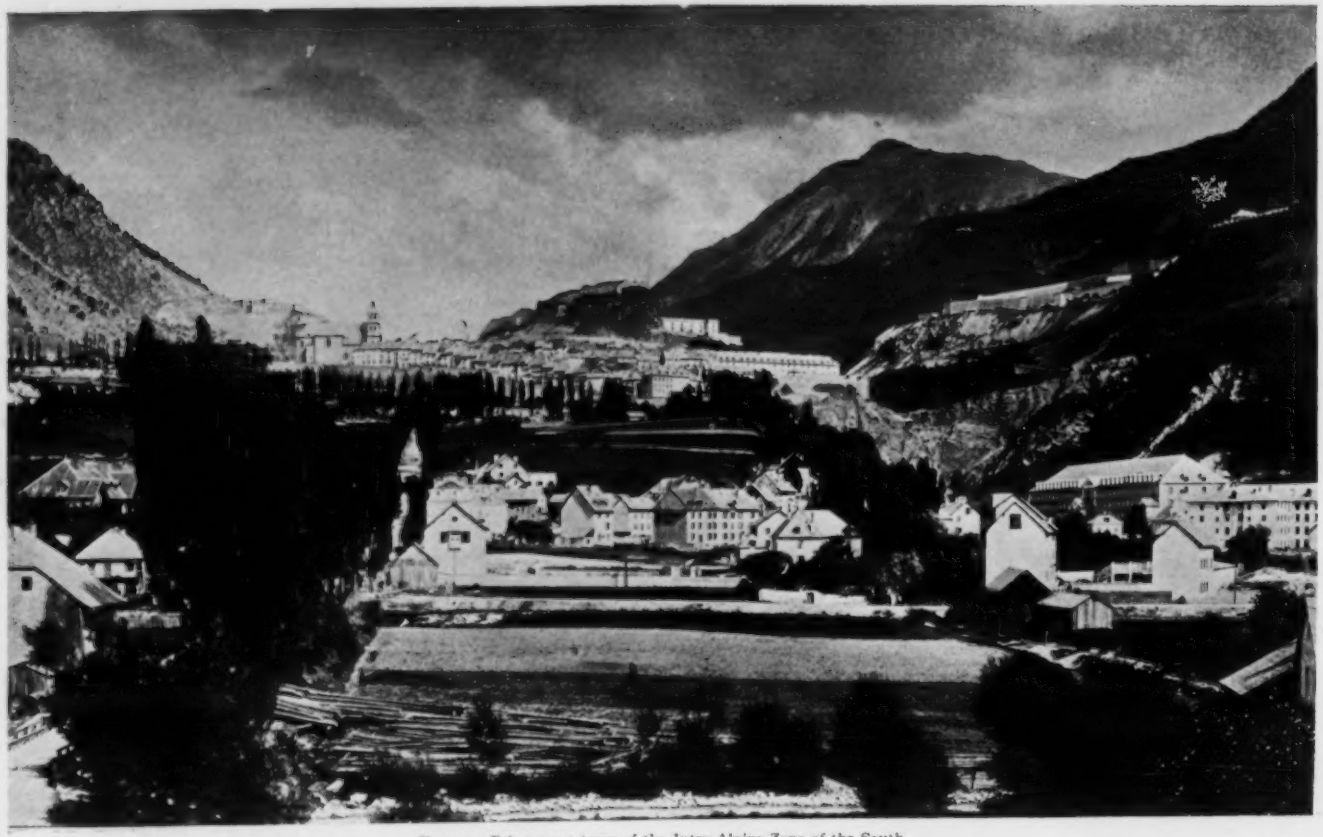


FIG. 15—Briançon, a town of the Intra-Alpine Zone of the South.

Intra-Alpine Zone

Of the four divisions of the southern Alps the Intra-Alpine Zone is the one most closely resembling the corresponding zone of the north. In the great thickness of overthrust folds it exhibits the same diversity of hard and soft rocks and the same variety of forms—ample basins deep as that of Briançon, longitudinal valleys of notable dimensions, transverse defiles whose floors are interrupted by the *verrous* (barriers of hard rock) characteristic of many glaciated Alpine valleys, high valleys, broad and open with gently sloping sides. Dryness is pronounced because of the distance from the Mediterranean. At Briançon is registered the smallest rainfall in the French Alps, 587 millimeters. Dryness and clearness of the air in this elevated region, so sheltered and so sunny, make it one of the most salubrious spots in Europe.

The altitude is considerable. Although the summit levels rarely surpass 3,000 meters, the mean elevation of the zone is greater than that of the north—a fact indicative of the less advanced stage of evolution of the relief. Here are situated the most elevated towns and villages of the French Alps. Here cultivation is carried on at the greatest elevations, and the upper limit of the forest likewise attains its highest level (2,500 meters). However, these lands are but ill-exploited. Isolation has retarded agricultural progress which remains based on polyculture and the extensive raising of sheep. This is the part of the French Alps where population has had its most rapid decline in consequence of extensive emigration both internal to Marseilles and external to Mexico and South America.

On either side of the climatic line dividing the French Alps into northern and southern sections profound differences are exhibited by the respective regions, always to the disadvantage of the southern section, less open, less penetrable, less "humaine."

MACKENZIE RIVER DRIFTWOOD*

By E. M. KINDLE
Geological Survey of Canada

All explorers who have an acquaintance with the Arctic coasts of America are familiar with the driftwood which in many places encumbers the shore line. Along many parts of the Arctic coast of Alaska and Canada vast quantities of forest débris consisting largely of good-sized logs and trees are piled up on the beach where the adjacent land affords nothing in the shape of timber larger than the Arctic willow, which seldom grows higher than a man's head.

SOURCES OF DRIFTWOOD ON THE ARCTIC COASTS

The *Fram* expedition collected 40 samples of the drift logs from the coasts of the Arctic Archipelago, and these have been determined by Dr. Ingvarson who recognizes three main sources for the wood.[1] The first is the Yenisei and Lena Rivers of Siberia, the second is the St. Lawrence, and the third is the coast of Norway. The Mackenzie River is not mentioned. In the writer's opinion it is second only to the Siberian rivers as a source of Arctic coast driftwood, and he here records his own observations concerning it.

DRIFTWOOD ON THE MACKENZIE

One might easily spend a single season on the Mackenzie, as the writer did in 1917, without learning that it furnished a very large amount of driftwood to the Arctic coast. During that season the driftwood seen consisted of occasional floating trees or widely deployed trains of forest débris. The *voyageur* sometimes utilizes one of the larger trees which still retains the branches, to make progress against an upriver wind. The deeply submerged branches cause the strong subsurface current to bear such a tree and any canoe which may be attached to it into the teeth of an upriver breeze as effectively as the underwater sail expedient, which is often resorted to when a floating tree is not available. Even in fair weather the floating tree is often made use of to save time for the *voyageur* on the Mackenzie. By lashing to a suitable tree he can cook his meals while proceeding on his way. If for any reason night travel seems desirable, the canoe may be secured to an Arctic-bound tree at bedtime and an undisturbed sleep obtained.

The relatively small amount of driftwood seen on the Mackenzie in 1917 is due to the fact that flood conditions did not occur on any of its tributaries

* Published with the permission of the Director of the Geological Survey of Canada.

[1] Fredrik Ingvarson: Die Treibhölzer auf dem Ellesmere-Land, in "Report of the 2nd Norwegian Arctic Expedition in the *Fram*, 1898–1902," Vol. 3, No. 24, pp. 1–57, Christiania, 1911.

FIG. 1

FIG. 2

FIG. 3

FIG. 1—Driftwood on the Mackenzie River near Old Fort Good Hope.

FIG. 2—Area kept free of forest by ice action. Northern bank of the Great Bear River above Mt. Charles.

FIG. 3—View of ice ramparts on the Great Bear River above Mt. Charles, looking upstream. The rampart on the far shore has an average thickness of about 20 feet.

that year, and though a great carrier of driftwood the Mackenzie is not itself a great producer. The writer has elsewhere remarked that the vast quantity of driftwood carried by the Slave and its tributaries ends its northward journey in Great Slave Lake.[2] In the same place he has pointed out some of the contrasting features between the Mackenzie and such streams as the Peace and Athabasca Rivers which materially affect the relative amounts of driftwood produced by them. Because of the comparatively straight course and the frequency of boulder-paving the Mackenzie—except in the delta—takes from its own banks a relatively small toll of trees. By far the greater part of the driftwood which it bears to the Arctic Ocean comes from its western tributaries. Great Bear River, the only large eastern tributary, receives its crystal clear and very cold water from Great Bear Lake, which retains the driftwood as well as the silt which enters its basin.

Driftwood and Ice Jams on the Great Bear River

Like other subarctic streams the Great Bear River contributes from its own banks a small amount of driftwood during the spring break-up, as a result of the destructive grinding and uprooting power of the great volume of moving ice which is brought to bear locally on the river bank forests by ice jams. Immediately above Mt. Charles[3] on the northern bank of the Great Bear is an area large enough for the maneuvering of an army which ice action keeps permanently free of forest growth. It is the result of rather special conditions. The channel is here relatively narrow and the water swift. Ice forms to a great depth on and near the banks because the river repeatedly breaks through and overflows the ice-covered surface. The end of winter finds a great ice dam more than 30 feet thick built across the river just above Mt. Charles, a circumstance which makes the formation of an ice jam at this point an annual event. In 1919 as late as July 30 ice ramparts 20 to 30 feet thick were found bordering Great Bear River above Mt. Charles for more than a mile. These consisted not of the cemented blocks of jam ice but of ice which had formed in place—the ends of a great winter ice dam.

The Principal Source of Mackenzie Driftwood

The Gravel, the Peele, and other large western tributaries of the Mackenzie doubtless carry notable quantities of driftwood into the main stream, but the great bulk comes from the Liard River. The timber growing on the banks of the Liard and its southern branches is about as large as that found on the Peace and Slave Rivers, and its driftwood includes many trees from one to two feet in diameter. The unusually high stage which the Liard reached in 1919 set afloat a vast quantity of stranded logs, many of which

[2] E. M. Kindle: Notes on Sedimentation in the Mackenzie River Basin, *Journ. of Geol.*, Vol. 26, 1918, pp. 341–360.

[3] Deep glacial ice grooves were observed in the limestone trending east and west on one of the highest points on Mt. Charles at an elevation of about 1,400 feet above the river.

had started their northern journey in previous years. At the time the mouth of the Liard was passed on July 1, it was discharging very little driftwood. The vanguard of the main volume of the Liard driftwood reached Old Fort Good Hope on the lower Mackenzie about July 13. At that time the writer was using a canoe a short distance above the old fort and had an opportunity to get a clear conception of the great volume of the floating mass of trees, logs, limbs, and bark. The immense volume of this floating mass of travel-scarred tree trunks and forest débris greatly exceeded anything previously seen or imagined. In general it formed a nearly continuous mass a quarter of a mile or more in width. When, as frequently happened, the mass of drift spread out under the influence of a breeze or current which carried it toward the middle of the river the width often exceeded a mile. Walking over this driftwood was often more feasible than canoeing through it. The closely packed phase of this particular exodus occupied about four days in passing a given point. Detached masses of small size and single, widely scattered logs followed it for several days. Spruce and poplar comprise the great bulk of the Mackenzie driftwood. Here indeed is a mammoth supply of pulp-wood delivered at tidewater, cutting and transportation free, that merits the consideration of any enterprising paper company which can solve the commercial problem of transportation around the Alaskan coast!

This vast contribution of driftwood eventually comes to rest chiefly on the coast of Arctic America and the islands west of Greenland. Frank Russell, traveling down the Mackenzie delta and along the coast to Herschel Island, remarked the immense quantities of driftwood brought down by the Mackenzie "strewn for hundreds of miles along the coast. . . . The sand beaches of the coast are literally covered with the white trunks from which the bark and branches have been worn."[4]

Other travelers have noted the large quantities of driftwood seen along the Arctic coast east of the Mackenzie, which is evidently its principal source. Dr. R. M. Anderson has informed the writer that he found it much more abundant on the western than on the eastern sides of projecting points along the shore east of the Mackenzie. On the coasts of Victoria Island and Banks Land seen by Dr. Anderson, driftwood was scarce as compared with the mainland.[5] That it is distributed far and wide throughout the Arctic Archipelago, though less abundantly than on the mainland, there can be little doubt.

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[4] Frank Russell: Explorations in the Far North, State Univ. of Iowa, [Iowa City], 1898, p. 142.

[5] Compare also R. M. Anderson (Recent Explorations on the Canadian Arctic Coast, *Geogr. Rev.*, Vol. 4, 1917, pp. 241–266): "At Collinson Point . . . driftwood fuel was abundant, as it is in most places on the coast for two or three hundred miles on either side of the Mackenzie River delta."

THE EVOLUTION AND DISTRIBUTION OF RACE, CULTURE, AND LANGUAGE

By GRIFFITH TAYLOR
University of Sydney

[With separate maps, Pl. I, facing p. 116]

Introduction

In a recent paper[1] I attempted to show that the chief ethnological characters of man developed largely as a result of marked changes in climate during the Pleistocene age. I showed that the various races are distributed in zones about Central Asia. The most primitive races, the *original* Negritos, occupy or occupied the most distant or least attractive portions of the outer zone. Next come the Negro; and then is a zone including the Dravidian races, the aborigines of Australia, and probably the Botocudo of Brazil. Within in succession follow the Iberian, Aryan, and early Mongolian zones, even more fully represented in the New World than in the Old. Lastly are the late Mongolian peoples occupying the highlands of Tibet and the northwest of China.

It is the purpose of the present paper to show how these migrations from Central Asia occurred and to correlate with them the evolution of the culture of the folk composing them. The order of discussion is as follows:

1. The value of the cephalic index as a test of evolution. Upon this factor my zones are primarily based. I also make some suggestions which may help to explain the changes in color which have vexed ethnologists in all schemes of classification using this factor.

2. The changes in elevation and in coast line which have masked the old "corridors" used by man in his migrations. The position of the deserts has also varied considerably during the Pleistocene.

3. A series of maps which illustrate what I believe to be the stages in the populating of the world by the hundreds of diverse races recognized by the ethnologist.

4. The cultures of the varied people in each zone. It is shown that they agree in many important culture details—no matter how far they may be separated from each other.

5. The factors controlling the growth of a high civilization. It is shown that environment is a more important determinant than heredity. As the

[1] Griffith Taylor: Climatic Cycles and Evolution, *Geogr. Rev.*, Vol. 8, 1919, pp. 289–328. A full summary of this appeared in the *Melbourne Herald* dated August 26, 1919.

environment changes so does the civilization wax and wane, and so different races rise to eminence and then sink into oblivion.

6. Language, perhaps the most important single aspect of culture and the hardest to correlate. I hope to show, however, that each zone has its own common linguistic features, a recognition of which would be of great service to the philologist.

7. In an appendix the suggestions as to the causes of the controlling climatic cycles, which I made in my earlier paper, are modified in some degree, in accord with the research of G. H. Darwin and others.

Part I

The Cephalic Index and Other Criteria

There is a natural belief among most races that one's own people ranks highest of all nations. The Papuan despises the Negrito, the Taniel looks down on the Veddah, the Masai on the Bantu farmer, the "Dago" scorns the Semitic Arab. The Chinese with a culture dating back to 10,000 B. C., the Yucatan Mayas with an elaborate civilization in some respects higher than that of the British Isles at the same time, the Javanese and Cambodians are all dismissed as inferior races without any obvious ethnological reason save that they have not progressed so rapidly in the last 800 years as the white races of Europe. Since man has taken probably one million years to rise from an apelike ancestor, such a small space of time (equivalent to one day in three years) can have no bearing on race variation.

Of all the coefficients which have been used to classify man, the measurement of the shape of the cranium is still in my opinion the best *single* standard. Moreover, it is still one of the most generally determined and so offers greater facilities for comparison than any other. The most admirable demonstration of the value of the cephalic index in the study of the broader problems of anthropology has been made by Ripley in his masterly "Races of Europe."

In August, 1919, I published a chart based on the cephalic index (breadth expressed as a percentage of length) which led me to infer that the yellow type of man had developed from the Aryan type. My belief that the roundheaded cranium (Mongolian) is the later and higher type is corroborated by the results of many investigators, of whom Macalister and Venn may be cited.

Professor A. Macalister (1897) states that "the infantile and primitive skull is relatively long, and that there is a gradual change, phylogenetic (racial) as well as ontogentic (individual), towards brachycephaly."[2] Up to a certain limit this is certainly correlated with, and is apparently produced by, cerebral activity and growth. In the process of development in the individual and the race the frontal lobes of the brain grow more

[2] Quoted in A. H. Keane: Man Past and Present, rev. edit., Cambridge, 1920, p. 511.

rapidly and tend to fill out and broaden the skull. Professor Thompson has shown the same effect graphically by his model of the skull.[3]

Dr. Venn gives figures for Cambridge undergraduates showing that from 19 years to 23 years their cephalic indices increase from 77.9 to 79.2.[4] Later on the frontal bones thicken, and this ontogenetic change is masked. Other writers, however, do not believe that this change to brachycephalism is uniform through life. As the various portions of the brain have very different functions and develop independently, we cannot expect simple or exact correlations. To some ethnologists the undoubted merging of races is a stumbling block. But the merging of colors in the solar spectrum does not invalidate the main phenomenon, i.e. the sequence of colors which is always constant.

In many features the Mongolian is at least on the same level as the white race. The Mongols of Central Asia and of the American Cordillera share with the Alpine (early Mongol) folk of central Europe the honor of possessing the highest cephalic index. They are of course furthest removed from the Negro and Negrito in this important respect. The same order obtains as regards orbital and aural indices and in the cross section of the hair. As regards cranial capacity the white and yellow races are ranked together by Duckworth, though Clapham states that the average weight of the Chinese brain is greater.[5]

Probably when sufficient data are collected we shall find that the evolution of man is epitomized in the children of the races. The recapitulary theory would demand that the Mongol *child* should show criteria somewhat resembling those of the white *adult*. The white child again is more dolichocephalic than the adult and so resembles the Negro. The black child in some respects approximates to the apes.

Color

The control of the color of the skin by climate seems at first sight hardly warranted when we have such anomalies as the fair peoples of northern India and the dark Tasmanians and dark Eskimos in cold regions. But, if we take into account the migration belts and more particularly the *average* climate during the whole evolution of a race, the problem becomes less complex. Let us tabulate the main races with reference to head form, color, and temperature of the region now occupied.

The intensely black races are all dwellers in hot countries and are all very dolichocephalic. They all belong to the three earliest migration zones, i.e. Negrito, Negro, and Hamitic. With this class we may place the lower Melanesians, though they may contain some Aryan blood.

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[3] Quoted by W. L. H. Duckworth: Morphology and Anthropology, London, 1904, p. 262.

[4] John Venn: Cambridge Anthropometry, *Journ. Anthropol. Inst.*, Vol. 18, 1889, pp. 140–154; reference on p. 152.

[5] Crochley Clapham: On the Brainweights of Some Chinese and Pelew Islanders, *Journ. Anthropol. Inst.*, Vol. 7, 1878, pp. 89–94.

In almost every case these dark tribes have lived for untold ages in hot climates. They have never varied their climatic environment since their original development in the hot plains of southern Asia. The Australians

TABLE I—HEAD FORM, COLOR, AND TEMPERATURE
(*Average regional temperatures in degrees Fahrenheit*)

	COLOR	DOLICHOCEPHALIC	MESATICEPHALIC	BRACHYCEPHALIC
I	Coal Black	Guinea Blacks (78°)	Bishari (80°)	
	Sooty Black	Papuan (80°) Solomon Islanders (80°)	Dravidians (78°) Melanesians (80°)	
	Chocolate Brown	Australian (75°)	Some Hindus (78°)	
II	Copper Red	Niam-Niam (78°)	Algonquian (60°) Maropa (Bolivia) (60°)	
	Yellow Brown	Eskimo (20°)	Guarani (75°) Samoyede (20°) Malay (80°) Plateau Indians, U.S.A. (50°) Tehuelche (50°)	
	Olive Yellow		Polynesian (70°)	
III	Olive White		Italian and Levant (60°) Semites (70°) Japanese (50°)	
	Pale		Western European (50°)	Alpine (50°)
	Florid		Scandinavian (40°)	Finn (40°)
IV	Clear Yellow		Hottentot (60°) Brazilian Indians? (75°)	Chinese (50°) N. W. Amerind (40°)

The color data are chiefly from Paul Topinard: Anthropology, London, 1890, p. 344; and from W. L. H. Duckworth: Morphology and Anthropology, London, 1904, p. 353.

have always been much more numerous in the tropical portions of the continent. The Tasmanians have probably been in Tasmania for a few thousand years only, whereas they spent half a million years in the tropics.

There is a strong reddish tinge in the primitive negro skin which is very evident in the infant stage. This persists in some cases—as in the Niam-

Niam of central Africa. Is it not possible that the coppery color of the eastern Algonquian tribes is the same primitive color? The latter belong to the same Hamitic group as the southern Hindu—and have perhaps not yet had the color bleached out of them by their long sojourn in cool countries. The Maropa Indians of the Bolivian lowlands may owe their copper color to a similar cause.

In Group II the dark yellow or yellow-brown folk are all mesaticephalic and, except the Eskimos, dwell in warm countries. The Eskimo is, I believe, an extremely mixed type with a large amount of negroid blood, as his head form shows. Like the Negrito he occupies the least attractive portions of the earth and probably incorporates "débris" from all the ethnological groups. He has been bleached from the original red-brown color to a dirty yellow-brown. The Samoyede is of later (lighter-colored) ancestry; but he has lived for a shorter time in polar regions and so has arrived at about the same color as the Eskimo.

In Group III are the white races. They are of two types. (a) Bleached dolichocephalic brown folk who have moved into the cool damp borderlands of the Eurasian land mass from Africa. They include the Pelasgians in the south of Europe and probably many Nordics in northern Europe. (b) Bleached brachycephalic yellow folk from Central Asia like the Slavs, Finns, and Japanese, who also now live in the cooler moister portions of Eurasia.

In Group IV are the true Mongolians of eastern Asia and of the American Cordillera. They are usually very brachycephalic, showing their late evolution, and have only lately moved out from the desiccated regions of Central Asia. The Hottentots are Iberians (Hamites) who have dwelt in a similar environment. As regards the Brazilian Indians whom Gerland (Berghaus' Physikalischer Atlas) charts as clear yellow, every migration zone is represented in this huge territory—with great color variation as Whiffen shows clearly—and until further anatomical data are obtained it is impossible to classify these races. The reddish-yellow color of certain primitive forest tribes may be the original negro color slightly bleached by their life in the thick shadows. I have no doubt that many dolichocephalic tribes will be found in the depths of the selvas.

Summing up it will be found that the sequence yellow, white-olive-brown, dark brown (black) occurs in every direction around Tibet except perhaps in the little-known Brazilian region of South America. Even here the extinct Charrua of the southeast (Uruguay) were very dark.[6] Thus the color evidence on the whole agrees very well with the migration zones based on anatomical criteria.

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[6]Orestes Aranjo: Historia de los Charrúas, Montevideo, 1911, p. 51.

Part II

Changes in Elevation

The great white civilizations of the day have grown up chiefly on the borders of the Atlantic Ocean. One result of this distribution is that until recently many geologists had perhaps too strong a belief in the permanence of continental morphology. In these regions near the North Sea and near the Alleghanies, though slight changes in the continental shelf have occurred

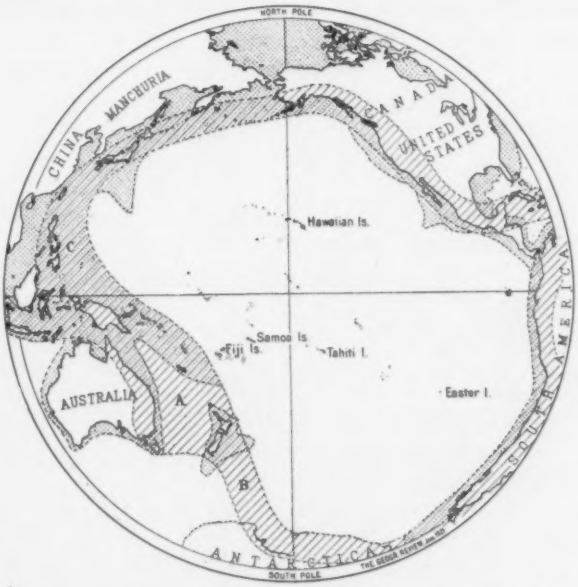

FIG. 1—The most mobile region of the earth's crust. The chief fault and earthquake belt (mainly after Hobbs) is indicated by ruling: the areas covered by terrigenous deposits (after Murray) by stippling. Much of the region indicated, except about the areas marked *A*, *B*, and *C*, was dry land in early Pleistocene time.

in late geological times, there are no such stupendous bucklings as characterize the coasts of the Pacific or the "Alpine Storm" across the Old World.

In eastern Australia, also, crustal movements have occurred on a somewhat reduced scale, but certainly quite recently in geological time. The canyon of the Barron River in northern Queensland, the intricate network of the coastal drainage, the grand valleys of the Blue Mountains (perhaps the finest dissected monocline in the world), the ten great block faults and graben of the southeast are all of very late Tertiary age. There is little doubt that earth movements are still affecting us here, as elsewhere around the Pacific.[7]

[7] See Griffith Taylor: The Australian Environment (Especially as Controlled by Rainfall), *Commonwealth of Australia Advisory Council of Science and Industry Memoir No. 1*, Melbourne, 1918; *idem*: Physiography of Eastern Australia, *Commonwealth Bur. of Meteorol. Bull. No. 8*, Melbourne, 1911.

The most mobile regions of the crust, those that have suffered the greatest movement in a vertical direction, are within the well-known earthquake belt. Pirrson and Schuchert definitely assign the volcanic outflows of the Pacific, which accompanied these movements, to the Pleistocene.

As a result of much evidence of this kind we must agree that the present age is one of rapid geological evolution. Especially in connection with the old land bridges and corridors connecting the large land masses is this concept of recent marginal change of paramount importance.

For instance, Hedley has shown that the Bass Straits have sunk so recently that much of the marine fauna at each end of the Straits has still not merged.[8] This explains how the Tasmanians crossed over "dry-shod" from the mainland. Hedley is also collecting similar evidence with regard to a continent between the New Hebrides and Queensland. Much greater changes in the seas can be justifiably assumed where greater elevations occurred alongside.

It is highly probable that the Indo-Gangetic plain was a wide strait not far back in the Pleistocene. This would partly explain why the Negro race is absent in India and why the Dravidian race was here preserved so near the cradle of human evolution. In all other directions, where it was unprotected by waters or marshes, this race has been driven forth by higher cultures.

It seems reasonable to assume a large Malayan continent extending from Burma to Borneo. Moreover there is nowhere else in the world so complex a system of rivers as in the Burmo-Chinese marches. Such a physiography is indicative of recent topographic changes.

I have advanced arguments elsewhere showing that the Lake George rift in eastern Australia occurred only a comparatively few thousand years ago.[9] The typical broken drainage lines of eastern Australia with rivers rising on the elevated coast line are reproduced all round the Pacific especially on the American side.

In Alaska we know of a rise of 47 feet as the result of one earthquake. The coastal scarp of California exhibits wave-cut terraces as high as 1,500 feet above sea level. Along the American coast from San Francisco to Chile the traveler has almost constantly in view these giant steps in which the mountains have been uplifted from the sea. In the central Andes Berry has shown that since late Tertiary or Pleistocene times there have been differential vertical movements amounting to a minimum of 13,500 feet.[10]

The terrigenous deposits on the floor of the ocean lend striking confirmation to this hypothesis. It is of course recognized that modern rivers contribute much to these deposits, but wide belts are found in Bering Strait,

[8] Charles Hedley: The Effect of the Bassian Isthmus Upon the Existing Marine Fauna: A Study in Ancient Geography, *Proc. Linnean Soc. of New South Wales*, Vol. 28, 1903, pp. 876–883; reference on p. 878.

[9] Griffith Taylor: The Lake George Senkungsfeld, *Proc. Linnean Soc. of New South Wales*, Vol. 32, 1907, pp. 325–345.

[10] E. W. Berry: The Age of the Bolivian Andes, *Proc. Natl. Acad. of Sci.*, Vol. 3, 1917, pp. 283–285; see also Isaiah Bowman: The Andes of Southern Peru, New York, 1916.

off Oregon, off the Gulf of California, and again on both sides of Patagonia and Argentina. The coasts of Siberia and especially of China are bordered for 700 miles by a belt of these deposits. The whole of the Malayan Seas is covered with them. They connect New Guinea to the New Hebrides, forming an area which agrees almost exactly with the Papuan ethnological region. Hence there is ground for the belief that the Pacific Ocean was smaller in the Pleistocene period, being reduced by a belt of land varying in width from 100 to 700 miles. Moreover, it is equally important to note that the rugged cordilleras which so handicap communications all round the Pacific were undoubtedly much lower and less dissected—and in all probability less folded—in mid-Pleistocene time.

In conclusion it may be stated that the uniformitarian theory of geological evolution, though true enough through most of the record, applies only in modified form to the Pliocene and Pleistocene epochs, for we are living in one of the most variable and stimulating periods of geological history. This is far from suggesting adherence to the old catastrophic theory, for even today all Nature's processes are processional rather than paroxysmal.

Mountains and Deserts

There are two types of deserts which concern us in the present study: the trade-wind desert, which lies along the tropics; and the rain-shadow desert, which is so striking a feature of Central Asia and to a lesser degree occurs in the western United States and Patagonia.

In my earlier paper I showed that the cooling of the temperate regions which marked the Pleistocene led to an equatorward movement of all the climatic belts, including the trade-wind deserts. There was a compensating improvement in higher latitudes, e.g. in the southern Mediterranean countries, in Persia and Mesopotamia, in Cape Colony, in Utah, and in southern Australia. This condition is now being reversed, and the laterites and other products of aridity formed in the Pleistocene desert lands near the equator are now being disintegrated and removed by the more frequent rains of today.[11] The rain-shadow deserts depend very largely on mountain barriers. This class of desert was of much less extent during the earlier history of man. It has been shown that the Himalayas, the Andes, and Rockies have probably added many cubits to their stature quite recently. Before this growth occurred the arid plains of Tibet were warm grass-covered steppes. The now desolate *punas* of Peru were fitted for human occupation. The Great Basin of the United States was filled with fresh water of which the Salt Lake is a very degenerate descendant.

The conditions in Egypt and northern Africa have deteriorated remarkably since the times of the ancient Pharaohs. It seems likely that the unspeakable Turk is by no means wholly to blame for the misery of the Oriental lands which he has dominated for centuries. The dry features

[11] H. I. Jensen, private note *re* Northern Australia.

here, however, are due to the swing of climatic belts rather than to the growth of mountain barriers.

Part III

Populating the World—the Major Stages

It is thus obvious that the factors controlling the evolution of the human races are complex, but not, I believe, undecipherable. *Heredity* certainly determines race, but largely because man's ethnology has been the result of age-long residence in the Asiatic cradle—where racial characters have slowly been developed. Even here it is the varying *environment* which has very slowly molded the race. But his status and place in the scale of civilization have been largely controlled by his *environment* after he has moved out into the world. Nothing is more striking than the slight factors which have apparently led to such mighty results. The original Fuegian moved to the northeast from Asia; the Goidel moved to the west. Yet one is now almost the most primitive of races; the other partly builds up the sturdy Scotch race playing a major part in the control of the activities of the world. Yet these races are ethnologically akin.

The chief stimulus determining the evolution of man has been the unique variation in the climate of the Asiatic land mass during late Tertiary time.

In my earlier paper I described briefly the reasons for my belief that the Negrito was the earliest form of man, and that he originated somewhere between Persia and Malaya. One important feature of the Negrito migration was the numerical inferiority of the tribes. They were never able to resist the advance of stronger peoples, so that tribes were often almost annihilated and the women distributed among the conquerors. The resulting children would conceivably form a despised race which would tend to join their dwarf fellows in the forests. Some evidence of a primitive dwarf Negrito race is found in all the continents, but nowhere is there a race which has not mixed with the neighboring tribes to some extent. Hence we find, as will be shown later, that the head form is much more varied than in any other of the major races of mankind. Undoubtedly the most primitive Negritos are found in the forests of central Africa and include the Akka and Batwa.

Negrito folk have been doubtfully described from Peru, southern Chile, and Venezuela in America.[12] There is no doubt that Bushmen formerly existed in northern Africa and in western Europe (i.e. some Aurignacian people).

The Folk in the Günz Ice Age

In Figure A, Pl. I, I have attempted to reconstruct the continents during the Günz Age.[13] The date of the change from apes to man is usually placed

[12] On a possible pygmy race in Central America see S. P. Verner: The San Blas Indians of Panama, *Geogr. Rev.*, Vol. 10, 1920, pp. 23–30.

[13] For a correlation of the stages of Penck and Brückner (Die Alpen im Eiszeitalter, Leipzig, 1909) see F. Leverett: Comparison of North American and European Glacial Deposits, *Zeitschr. für Gletscherkunde*, Vol. 4, 1909–1910, pp. 241–295; 320–342.

in the Pliocene. During the early Pleistocene I imagine that the Negrito type and probably the Neandertal type were both developing. The former probably gave rise to the various pygmy types and the latter perhaps to the Negro type.

We get no certain evidence of man in Europe until the later Ice Ages, but it is logical to assume that the primitive folk had evolved earlier in Asia; since we know that the later sequence of development was continuous in southern Asia.

In Günz times (which are dated at 800,000 B. C. for reasons given in my earlier paper)[14] a large ice sheet covered the high latitudes, approximately as shown. The trade-wind desert belt moved nearer the equator. The Malayan and Persian lowlands were probably covered with forest into which the Negrito folk retreated. It is probable that the Gangetic strait was in existence, so that most of the Negritos moved to the southeast and southwest before the on-coming cold. Their descendants are still most numerous in these two quarters. This separation into two diverse *wings*, occurs throughout the migrations.

The Günz-Mindel Interglacial

During the Günz-Mindel Interglacial the climate of Central Asia greatly improved. For some hundred thousand years the primitive types developed in the forests which has moved north again after the retreating cold. The tribes gradually spread and became accustomed to a cooler climate than that suiting their ancestors. Thus were evolved the true Negro peoples and later the Bantu.

Towards the Close of the Mindel Ice Age

The Negro races moved to the south with the migration of the forests and of the fauna on which they preyed (see Fig. B, Pl. I). They drove the scattered Negritos before them. We find few true Negro people to the east of the center of dispersion, though some tribes of this migration are seen in the frizzy-haired, very dolichocephalic Papuans and Melanesians. Some traces also occur in the negroid Susians of southwestern Persia.[15]

This distribution leads me to suppose that the Deccan was inaccessible and the Malayan continent not so readily reached as the broad lands of Africa. Skulls both of Negritos and Negroes are known from Egypt. Steatopygy and hair on the body are indicated in models from early graves, and this also demonstrates that the Negritos and Bushmen passed through Egypt on their route south. Similar artifacts from southwestern Europe probably date a little later but give us accurate information as to some of the earliest peoples of Europe. The direct path to Europe was blocked by the Ural Gulf, and all our earliest ancestors moved into Europe from the

[14] See also Appendix to this paper.
[15] See W. Z. Ripley: The Races of Europe, New York, 1899.

south. However, the negroid folk for the most part would keep to the forested country, which lay then as now near the equatorial regions.

The Bantu, both in culture and ethnology, come between the Sudanese Negroes and the Hamitic peoples. We have not much evidence as to whether they developed from the Negro tribes who remained in Asia or whether they originated very much later in the park lands of the Sudan on the borders of the Negro tribes. Johnston inclines to the latter belief and thinks that their language shows Pelasgian affinities due to Hamitic traffic across the Sahara.

It may be well to dwell for a moment on the "Hybrid Theory" of race origins, and use the Bantu as an example. One school believes that the Bantu is a cross between the Negro and the Hamite. They do not in general explain how the Negro reached Equatorial Africa nor how the Hamite occupied northern Africa; but, assuming these facts as inexplicable, they state that the Bantu is a merging of the two distinct races. This may be true, but to my mind it is more logical to assume that the stimuli which changed the ape man into the Negro continued to act and produced the Bantu and continued further and produced the Hamite. The results as regards distribution and as regards anatomy, culture, and language are not very different. Probably we shall never be able to say definitely where primitive "Asiatic" differentiation ceased to operate and the hybridization of adjacent tribes in their ultimate settlements began. Modern statistical methods combined with the graphic representation of racial characters will, however, go far towards the desired result. In the particular problem cited we may obtain evidence from the language and customs of the Susians. Are they primitive negroid or do they show Bantu affinities?

During the Mindel-Riss Interglacial

The climatic and competitive stimuli remained strongest in the center of the great Asiatic land mass. The cephalic index of the folk who fought the changing environment increased during this period from about 72 to 74 (see Fig. C, Pl. I). Thus was evolved the Mousterian. His most natural route for migration was obviously to the south and east, for we may assume that the Gangetic plain now rose out of the sea, and that the partial barrier to the Malay region (which may have been open water, very high mountains, or possibly unusually thick tropical jungles) was now removed. Many Mousterians moved to the west across the Red Sea into Africa, where they perhaps encountered the Bantu folk. At any rate we know they moved northwest along the Mediterranean coasts and entered Spain and France. Their skulls occur plentifully in these countries, typically at Moustier. Other hordes migrated into the Deccan pushing before them a few Negritos, who ultimately found refuge in the islands off India (Veddah in part, Andamanese, etc.).

It seems probable that nowhere was there any large population. All these

tribes lived by hunting, and it would be logical for them to be on the whole moving onward, so as to keep plenty of room between themselves and any succeeding tribes. They had all the world before them, and I doubt if any district became at all thickly populated till long after the last Ice Age.

The Riss-Würm Interglacial

The Riss Ice Sheet advanced from northern centers about 400,000 B. C. and its associated marginal climatic conditions drove most of these folk away from the cradle of the race. On its retreat there ensued the long years of the next Interglacial period (see Fig. D, Pl. I). In southern Asia developed the Iberian race, which gradually expanded and drove the Mousterians away on all sides. Man had become accustomed to a cooler climate, so that we find the Mousterians fleeing to the northeast and ultimately reaching America *via* the Bering Corridor. I am, however, disposed to fix their entry into the unoccupied continent about the time of the last (Würm) Ice Age, about 100,000 years ago.

During this Interglacial period Mousterian man occupied western Europe and the Malayan region. The latter was much larger than it is today; but, since no true mammals ever reached Australia, it seems likely that there was always a wide break somewhere between Java and New Guinea.

Bean has shown that the aboriginal folk all through the Philippines belong to this Mousterian (Australoid) migration,[16] possibly mixed with the Negrito.

The Würm Ice Age

As the last ice sheet advanced it drove forth the Aurignacian and Iberian peoples (see Fig. E, Pl. I). They spread fairly uniformly to the west, south, and east. They occupied the warm park lands especially in central India and around the Mediterranean. Large tribes must have moved to the northeast with the retreat of the Würm Ice Sheet, so that possibly there were more Iberians (including the earlier Aurignacians) in Manchuria and the vicinity than anywhere else.

At this date we may picture the scattered Mousterians spreading through North America and through Malaya into northern Australia. Probably they marched along the New Guinea tract, which was undoubtedly much broader and lower at this time. The trade-wind desert now occupied most of northern Australia. Probably New Caledonia was nearly joined to New Guinea, for the early Melanesian folk reached the former place presumably before navigation was of a high order. In a later section I discuss the possibility of some low-statured peoples (Aurignacians) forming part of this migration.

The Azilian Age

This was pre-eminently the age of great migrations (see Fig. F, Pl. I). The climate was becoming much warmer, and towards the close of this age

[16] R. B. Bean: The Racial Anatomy of the Philippine Islanders, Philadelphia and London, 1910, p. 233.

(about 40,000 B. C.) there is no doubt that in general it was warmer than at present in temperate regions. The great feature of this period was the broad corridor extending from Siberia to North America. It was quite free from ice, and the southern border in summer was no doubt a pleasant land resembling Scotland. The absence of the Polar current which now chills eastern Siberia would also greatly contribute to this result.

Meanwhile the Aryan and Mongolian peoples were arising in Central Asia and spreading forth, pushing the Iberians ever outward. It is certain that the interior of Asia altered completely in character during early Neolithic times. The great mountains rising to the south gave an excessive rainfall to northeastern India but deprived the Tarim Basin and Tibet of the most vital factor in civilization.

Hence we find a resistless pressure outward on the part of all the folk of Asia. The greatest migrations occurred to the northeast, where the resistance was least. For, as the first Iberians reached America, they would find a glorious country improving in climate and food supply the farther they moved to the south. One can picture a "stampede" of peoples such as the world had never seen before and can never see again. Only a few helpless Mousterians would flit through the woods ahead of them.

Movements in America

The woodlands would offer a much more tempting corridor and a better food supply than the open prairies to the east. Hence we may picture the Iberians moving almost due south at any rate as far as Mexico before they curved round to the east.

It seems probable that the topography of Central America was very different in Azilian times. As Huntington has shown, the climate was better than it is now even within historic times. Probably the migration zones themselves offer the best argument in support of an easy land route between the two continents. We find a parallel distribution of peoples. In both the northern and southern continent the broad "main" corridor lay along the open uplands of the west, while the more primitive tribes were pressed to the east away from the main route.

The Iberians in Europe and Africa

The Iberians occupied Egypt and almost the whole of Europe. They were a people with much architectural skill, the builders of the megalithic monuments. These monuments are found almost all over the world save where the lower races have held their ground. Thus we get them not only where Iberian folk still remain but also throughout central and eastern Asia and through Russia, where there are no Iberian peoples today. This fact seems to me to prove conclusively that the Megalithic folk were by no means a coast-loving people, moving eastward from North Africa to Poly-

nesia and America, as Elliott Smith suggests, but were one of the major migrations that spread *centrifugally* from Central Asia in all directions.

In Africa they followed the main corridor down the open park lands of the east; and their forerunners, the Hottentots, ultimately reached the extreme south. Here they were isolated by the huge numbers of Bantu who pressed across their track (from the northwest) at a much later date. The Hottentot in fact represents very closely what is called an "outlier" in geological language.

Place of the Semites

The Semites were probably the highest development of the Ibero-Hamitic migrations, rather than the lowest of the Aryan peoples. The merging of the Libyan Hamites into the Semites, and the much greater differences between Semitic and Aryan languages corroborate this. Moreover, in Melanesia we seem to get a closer relation between the Iberian and Semitic zones than with the later tribes of New Britain who are early Aryan, I believe (see also the lava-flow analogy, Fig. 9).

The Semites and Iberians are closely linked, the former being a late variety with many striking customs which they have carried all over the world. Hence has arisen the myth of the Lost Ten Tribes. The Jews proper are a small tribe who migrated from Palestine within the last two or three thousand years; but the allied Semitic migration reached America about 50,000 years ago, while various isolated tribes of the same type were probably first planted in portions of eastern Asia nearly 100,000 years ago. I shall deal with the evidence linking these pre-Aryan (Semitic) folk together in a later section.

Later the Aryan peoples also poured into America during early Neolithic times. Ethnology has not only developed very recently but also only among the white folk of western Europe, so that they naturally called their own kin the "Indo-Aryans." But 2,000 years ago an impartial ethnologist would probably have termed the western Europeans an unimportant offshoot of the great family of olive-white peoples with an index near 78, which moreover he might reasonably have named the "Indo-Amerind" family.

Early Alpine Folk in Europe

It seems probable that the first Asiatics in Europe were Alpine folk who had short heads (83–85) and who moved along the central highlands towards the close of the Azilian period. They brought in a new culture not necessarily equal to that of the African longheads. As I explain later, it seems to me almost certain that they spoke a primitive Aryan tongue allied to the Galcha of the Pamirs. We find these folk in the mountain regions of France and Switzerland as the Cevenole and Ladin peoples. I expect that a similar primitive structure and vocabulary will be found to ally the Ladin, Romansh, Illyrian, Ossete, Armenian, and Galcha languages; but I can find little data on the subject (see below).

A few of these early Alpine folk reached Britain, where they built the round barrows. But this was much later (in the Bronze Age), and they made no permanent impression on our dolichocephalic race.

Prehistoric Age and Later

The chief stimulus to change and migration of late years has been the desiccation of Central Asia. This is shown by the researches of Sven Hedin, Huntington, Sir Aurel Stein, and in fact by all who have traveled in Tibet, Mongolia, Turkestan, and Persia.

Many thousand years before Christ the Chinese started to move down from the Tarim Basin through the "Jade Gate" to occupy the upper basin of the Hwang Ho. To my mind they represent perhaps the latest development of the human race. The conquering Chinese of this early period were much more brachycephalic than the mixed race which now occupies the south and east of China. It is, however, this latter class which is best known to the foreigner, and they have usually been taken as of pure Chinese blood. But the invaders (with an index around 87) found China in the hands of Aryan and Iberian races, of whom many still survive in southern China. Some of these are the Miao-tse, Lolo, Hakka, Yao, Li, and Minchia tribes.

The Chinese set in motion the Tungus and allied people, who again found in the great corridor via the Bering region the line of least resistance. Probably other tribes had preceded them all through Neolithic times. These Mongolian hordes with cephalic indices from 83 to 88 moved along the western plateau of North America right down into Patagonia, where they are typically represented.

They have indeed made but two important incursions from the main corridor. The first is the great Shoshone-Muskogean migration which has taken brachycephalic Amerinds to Florida and to Lake Michigan. The second is the Carib incursion along the northern coast of South America.

Although the brachycephalics (83–88) are fairly uniformly distributed along the plateaus, there is strong evidence of surges from earlier peoples across their main path. Thus the Salishan peoples are probably of earlier origin (80–82) and occupy British Columbia.

The Shatter Belts

The last migrations have apparently been by far the most violent. They have found the world already occupied by more or less settled tribes, and in consequence a tremendous clashing and breaking up of races has occurred. This is especially marked in those regions for which I suggest the name "Shatter Belts" (Fig. I, Pl.I). The main line of disruption occurs all along the Great Corridor from the Malayan region through China, eastern Siberia, and the western coast of America. Here the débris of primitive tribes is

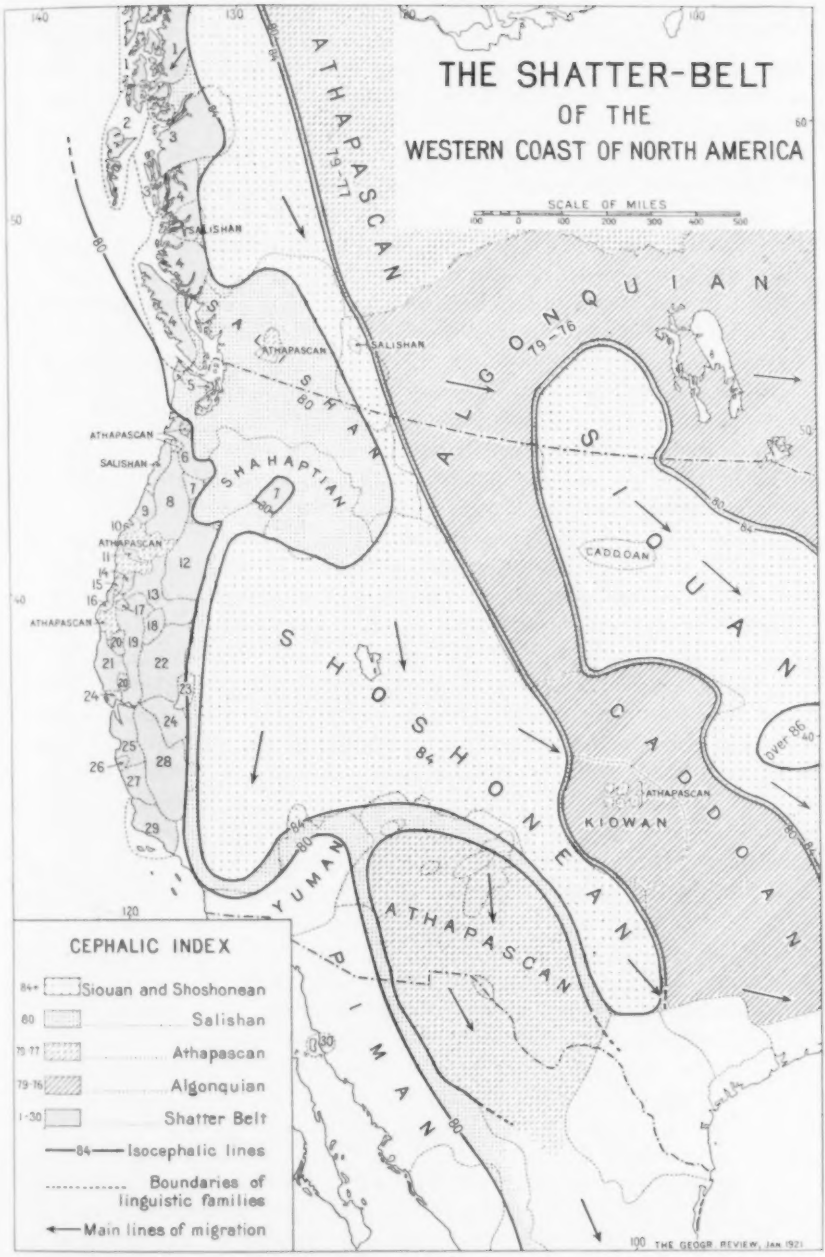

FIG. 2—The "Shatter Belt" of the western coast of North America. Ethnically and linguistically the term "shatter belt" is applied to a region, marginal to main routes of migration, occupied by a "mosaic" of tribes. The tribal distribution shown above is from the map by J. W. Powell (revised) accompanying "Indian Population in the United States and Alaska, 1910," Bureau of the Census, 1915. The linguistic families in the shatter belt are (besides Athapascan and Salishan): (1) Tlingit, (2) Haida, (3) Chimmesyan, (4) Wakashan, (5) Chimakuan, (6) Chinookan, (7) Waiitatpuan, (8) Kalapooian, (9) Yakona, (10) Kusan, (11) Takelma, (12) Klamath, (13) Shastan, (14) Quoratean, (15) Weitspekan, (16) Wishoskan, (17) Chimarikan, (18) Yanan, (19) Wihtun, (20) Yukian, (21) Pomo, (22) Maidu, (23) Washoan, (24) Moquelumnan, (25) Costanoan, (26) Esselenian, (27) Salinan, (28) Yokuts, (29) Chumashan, (30) Seri. Notice especially the Athapascan portion of the mosaic separated from the main tribe by the migration of brachycephalic Siouan and Shoshonean along the main corridor.

scattered like scum left by a great wave. Perhaps a closer simile is the line of shattered and altered rocks which marks the course of a great line of disruption in the earth's crust.

We find the mixed races of the Malayan region inextricably tangled. The Ainu and the Paleo-Asiatics occur in northeastern Siberia. Down the coast of British Columbia and California are four times as many distinct tribes as in the rest of North America. The small dolichocephalic tribes of California have been pushed to the west by the stronger brachycephalic folk. The important tribes of Athapascans of New Mexico are longheads, as are also many of the Piman tribes of Mexico (see Fig. 2).

Probably each of these shattered American tribes has a counterpart in the broader territory of the eastern peoples. We know that this is true of the Athapascans of Oregon and of the northern Plains. It is highly probable that the Salishan folk were originally connected with some of the (Sioux?) tribes of Iowa and Dakota. The Seri (76) of the Gulf of California are most marvelously preserved, and the congeners of these Iberian people will probably be found in the extinct Hurons of the far east, or possibly in the Tupi-Guaraní people of South America. Similarly we get Pano (in the Huallaga and Marañon basins) in the north and Yahgan in the south of South America, Bororo in Matto Grosso and Tehuelche in Patagonia as probable disrupted pairs in the southern continent.

In South America there is another shatter belt, where the more primitive tribes are driven down against the impenetrable forests of Brazil from their old highland homes. A crescentic belt of mingled tribes is shown by Chamberlain[17] in his ethnological map of South America. It starts in Colombia between the Chibcha and Carib regions. It continues southward between the Aymará and Arawak (forest) tribes. It curves round to the east about the Tapuyan tribes of eastern Brazil.

In the Old World the finest example is perhaps in the Caucasus, where Ripley shows a whole series of peoples f.om the longhead Kurds (77) and Tates, through the Alpine Abkhasians (probably from the Altai Mountains) and Ossetes (81–82; from the Pamirs center) to the Armenians (85; from the Pamirs) and Mongol Tatars (from the Altai center). Another such belt occurs along the margin of the Abyssinian Highlands where Sudanese, Bantu, Hamitic and Semitic tribes clash together.

Later Aryan and Mongolian Migrations

The great Polynesian migration occurred probably as a result of the Chinese thrust from Central Asia. Linguistic and ethnological data link the Polynesians with the Koreans, Japanese, Formosans, Indonesians, and Javanese. Legends and genealogies show that about the dawn of our era the early Polynesians were among the Malay islands. By 450 A. D. they

[17] A. F. Chamberlain: Linguistic Stocks of South American Indians, with Distribution-Map, *Amer. Anthropologist*, Vol. 15 (N. S.), 1913, pp. 236–247.

had reached Samoa and by 850 A. D. Tahiti. Somewhat before this one bold Polynesian had reached Polar ice in his huge war canoe. In 1175 A. D. the primitive Moriori (77) were driven out of New Zealand to the Chatham Isles. No doubt New Zealand was first reached several hundred years before this. Tahiti seems to have been a center of dispersal, as Percy Smith has pointed out in his interesting book "Hawaiki." We must however remember that Melanesians preceded the Polynesians to many of these islands at a much earlier date.

No doubt the early Mongolian folk of China and Japan were equally skillful sailors. It seems possible that some of the tribes migrated to America about the same time. The resemblances between the cultures of the Haida (82) and the Polynesians (80–83) have often been pointed out. Moreover, just as in Europe the Alpine roundheads (83) in part preceded the Teuton longheads (77), so we may perhaps see something of the same sort of anachronism in British Columbia; i.e. that the Salishan "spearhead" penetrated the more brachycephalic surrounding tribes instead of preceding them, as is almost invariably the case (see Fig. 2).

It is only so late as 1200 B. C. that the Aryans first appear in European history. Their exploits are sung in Homer, who describes the wars between the Trojan (dolichocephalic) Pelasgians and the Aryan (brachycephalic) Achaeans. The latter entered Europe by the Ural route.

We may picture the Goidels (76–77) at an even earlier time moving to the northwest perhaps from Africa and ultimately reaching Ireland. Then came the Brythons (77), possibly via the Danube, who also settled in Britain. Both these peoples found Iberian Picts in the country before them. The Itali who came down into Italy from the north were very largely composed of Alpine folk. They merged with the Iberian Etruscans and founded the Roman Empire. Many Aryans (Dorians, Achaeans) invaded Greece and displaced the Iberian (Mycenaean) civilization. The Teutons advanced from southwestern Asia along the northern plains of Europe and sent an offshoot, the Anglo-Saxons (79), into England about 500 A. D.

The migrations of the Keltae were both earlier and later than those described above. The Keltae are an Alpine brachycephalic race (83–88) akin to the Cevenoles and in no sense akin to the dolichocephalic Goidels and Brythons, who are also unfortunately called Kelts. They dispossessed Iberian people in France, central Europe, and probably in the north of Spain. I shall refer to the relation of the Keltae to the Teuton and Romance peoples in a later section.

The Slavs (82) are certainly an Alpine race allied to the Keltae, who invaded Europe (including Germany and Greece) in historic times.

The first true Mongol invasions, those of the Huns, occurred in the fourth century before Christ. The Lapps are also a Mongol race who have long dwelt in northern Europe. The Finns are allied to the Slavs but came from far to the east of the latter. Hence their language is Altaic not Aryan.

Part IV

The Evolution of Culture

This is a phase of science which has been treated very fully in many notable volumes. I propose here merely to discuss its relation to the migration zones already described. There have been many suggestions that similarity of custom implies a common origin; but where the custom alone is considered it has not been hard for opponents to show that the similarity of custom may be due to the common tendency of all races to evolve into higher types. I hope that I shall be able to demonstrate that in most cases these characteristic customs accompany marked anatomical resemblances. This union of such dissimilar criteria must surely point to a common ancestry of the several peoples concerned.

Zone I, Negrito Type

It is very difficult to correlate the Negritos, for two reasons. In the first place they are very shy and have nowhere been adequately investigated. In the second place there seems little doubt, as I have previously remarked, that there are no true Negritos left.

Dr. Birkner believes that there are varying stages of dwarfishness and that the Asiatic Negritos are only partially dwarfed. Some of the pygmies have the limb proportions of children rather than those of adults; and, as Duckworth logically suggests, these would seem to be the most primitive.[18] In the latter case the legs are shorter and the trunk longer than normal, and such features occur in the Uganda Negritos.

There seems no doubt that the Tasmanians were Negrito half-castes with the Dravidian Australians. As Sollas shows, the low cranial vault occurs in 75 per cent of the Tasmanian skulls, in 65 per cent of the South Australian, in 40 per cent of the Victorian, in 26 per cent of those in New South Wales, and in only 3 per cent in the highest Queensland aborigines. The language of the Victorian Kurnai and Narrinyeri is also allied to the Tasmanian. The latter people were collected together in 1835 and only numbered 203. In 1847 there were 48; in 1854, 16; in 1865, four women; and the last (Truganini) died in 1877. There are, however, a number of half-castes (with some white blood) still alive on Flinders Island in Bass Strait.

The Pure Negrito Extinct

There is no doubt that similar racial annihilation has often occurred in the history of man. To my mind this explains why we find no *dwarf negroid with peppercorn hair* (i.e. Negritos) with a lower head index than 73. The stronger Negro stock of Melanesia and of the Guinea Coast have

[18] Duckworth, *op. cit.*, pp. 483 *et seq.*

skulls with indices of 70 or lower. These Negroes are purer races than the Negrito of today but have been evolved later than the original (extinct) Negrito.

The culture of these (half-caste) Negritos is always low but varies with the proportion of foreign blood. The culture of the Tasmanians may be taken as representative of the lowest. They usually went naked but occasionally wore skins. They gashed themselves as a sort of primitive ornamentation. They built nothing so useful as the Australian "wurley," though the Tasmanian climate was much colder (55° F.). They used plain

TABLE II—NEGRITOS AND ALLIED FOLK

	NAME	CEPH. INDEX	CAPACITY (in c.c.)	HAIR	SKIN COLOR
Africa	Bambute	79.2	1,400	Peppercorn	Black
	Akka	74.4	1,100	Peppercorn	Red-Yellow?
	Batwa	74 ?		Peppercorn	Black
	(Bushman)	74.5	1,331	Peppercorn	Yellow
Australasia	Tasmanian	74.0		Frizzy	Chocolate Brown
	Tapiro	79.5		Frizzy	Black
	New Britain Islanders	73.0		Frizzy	Black
Asia	Semang	76.2	1,230	Peppercorn	Chocolate Brown
	(Sakai)			Wavy	Black
	Aeta	79.6	1,419	Peppercorn	Chocolate Brown
	Andamanese	82.1	1,266	Peppercorn	Black
	(Veddah)	71.5		Wavy	Red-Brown

wooden spears and clubs and rough stone scrapers and choppers. They had a rude raft like the Californian balsa, which probably enabled them to cross the narrow seas from Asia to Australia.

In Africa there are many grades of Negrito from the Batwa, Bambute, and Akka up to the Bushman (the last, however, are more properly considered with the Aurignacians or primitive Iberians). Similar variation is found in the southeast of Asia. The Kalangs of Java are now extinct but were extraordinarily simian in appearance. The Andaman Islanders resemble the Tasmanians in their low culture. The Sakai and Semangs of Malay have a considerable amount of Malay blood in their veins, but the latter show extreme prognathism. Many of them, like the Tapiro of Papua, are quite wild and keep aloof from civilization.

The Aeta of the Philippines have a head index of 82 which is much superior to that of most Britishers (78). They are undoubtedly Mongolian-Negrito hybrids. Some of these Negritos are thus brachycephalics, and naturally the higher hybrids are the least shy and therefore the best known

It seems wrong, however, to say that this primitive human type is normally brachycephalic,[19] for the more primitive Negritos are precisely the more dolichocephalic. They are already known with indices as low as 73 (New Britain) and 74 (Tasmania), and we may yet discover fossil examples of their crania below 69.

Zone II, the Negro Race

There are two well-defined regions occupied by the *lowest* Negro races. In Africa are the Sudanese and West Coast races, in the Australasian region are the Melanesians and Papuans from New Caledonia to New Guinea.

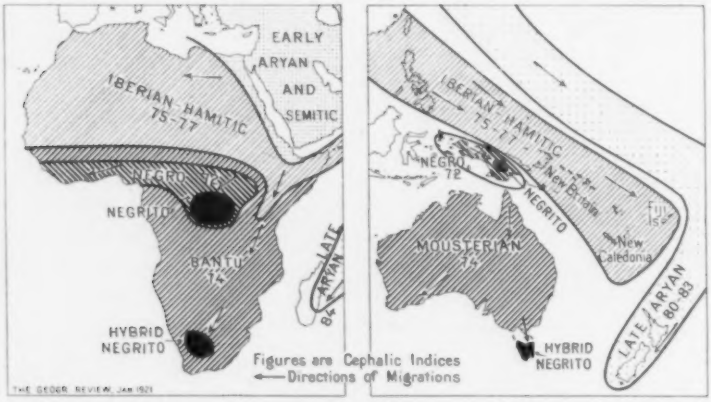

Fig. 3—Maps showing the distribution of races in Africa and Australasia (generalized). The parallelism suggests that the center of dispersion lies symmetrically between them, i.e. in Central Asia.

These resemble each other very closely in physical characteristics, as the following table shows.[20]

It is necessary to remember, however, that the Melanesian region, small as it is, is occupied by the representatives of many major races (see Figs. 3 and 10).

If the separation of the two lowest Negro types occurred in the Mindel Ice Age or thereabouts—as I postulate earlier—there is not much likelihood of any great resemblance in the customs of the two folks. Almost everything characteristic must have developed since that date, except the anatomical features mentioned previously. But in the drum language and in the totem and brotherhood institutions we have undoubted similarities between the *lower* Melanesians and the West African blacks. The primitive (i.e. complicated) nature of the structure of the languages is common to both; but, in view of the little knowledge which we possess on these points, one cannot stress this analogy.

[19] A. H. Keane: Ethnology, Cambridge, 1895, p. 243.
[20] After De Quatrefages from Keane's "Ethnology," p. 264.

A more interesting and suggestive parallel is shown by the geographical distribution of all the races in these two contrasted regions (see Fig. 3). Typical Aryans (77–80) are rare in both.

The true Papuans and western Melanesians (who also speak Papuan), with a head index about 72, have all the character of the lowest Negroes.

TABLE III—PARALLELS BETWEEN THE AFRICAN AND AUSTRALASIAN NEGROES

	CEPHALIC INDEX	CRANIAL CAPACITY	FACIAL INDEX	HAIR	SKIN COLOR
Central Africans	71.2	1,424 c.c.	70	Woolly	Chocolate to sooty
Melanesians	70.4	1,412 c.c.	69	Woolly	Chocolate to sooty

They are very excitable, voluble, and laughter-loving and even more cruel than the African Negro. In both cases it seems possible that early closure of the sutures of the skull prevents the growth of the brain. The Papuans of Astrolabe Bay could not kindle an extinguished fire and often ate their food raw. Cannibalism is still rife in the interior of Papua. They have the most primitive social institutions, and even totemic systems are undeveloped

TABLE IV—RACE PARALLELS IN AFRICA AND AUSTRALASIA *

CEPHALIC INDEX	RACE	ENVIRONMENT	AFRICA	MALAY-AUSTRALASIA
?	Negrito (a) (b)	Forests Cooler lands in extreme south	Batwa, etc. (Bushmen?)	Tapiro, Aeta, Kalangs Tasmanians
71	Lower Negro	Equatorial forests and park lands	Peoples of Guinea and Upper Nile	New Guinea Southern Melanesia
73	Higher Negro	Cooler park lands	Bantu	Australian
75 to 77	Hamitic and Semitic	Curving around to east of Negroes and equatorial forests	Ethiopians Masai Hottentot	Igorots and Micronesian Higher Melanesians Solomon Islanders
80 to 85	Aryan and later seafarers	Islands to east	Hova of Madagascar	Polynesians

* The Melanesians can be divided into four main groups. The most primitive (71–73) live in the south in Fiji, the New Hebrides, and New Caledonia. The next group (73–75) occupies the eastern end of Papua and the Dentrecasteaux Isles. The cephalic index of the Solomon Islanders is variable round 77; and that of the Papuan coast peoples from Hall Sound to South Cape is around 79. Allied to the latter are the Bismarck group.

for the most part. There is a tendency, however, to accept some animal, e.g. a crocodile, as a "god." In the Loyalty Isles their gods are mostly evil and (as among some of the Bantu folk) harrow the whole life of the tribesman.

In Africa, owing to his proximity to the Hamitic tribes and especially as a result of Moslem proselytizers, the Negro has developed a relatively high culture. But where this stimulus is absent he is much the same as his long-lost brother the Papuan of New Guinea.

The Bantu have no close homologue in Australasia. The Australian has much the same cephalic index (74), but the hair is curly and not woolly like that of the Bantu. No doubt the African is the more primitive biologically, but there is no comparison in the cultures of the two peoples. Nothing is so dangerous to a people as complete isolation. The natural barrier which preserved the Australian aboriginals from invasion also resulted in their remaining in the same low state of civilization for 100,000 years. At the first approach of a more progressive race they have almost vanished from the face of the earth.

There is a fairly close connection between the West Coast Negroes and the Bantu. The Wolof of Guinea and the Bantu language are somewhat akin.[21] Mandingo and Bechuana have similar totems. The Bantu religion is ancestor worship in the east and spirit worship in the west. Throughout, however, there is a strong belief in witchcraft and in gross superstitions.[22]

Zone III, the Mousterian Races

The most primitive examples of this zone are found in the Australian aboriginal. Though the latter is remarkably homogeneous, yet there are three major groups. The Victorian and South Australian coast blacks seem to have been the most primitive as stated previously. For instance they have no class organization.

The tribes of inland Queensland, inland New South Wales, and South Australia have maternal descent, and few of them use the womerah (spear-thrower). The tribes of the northern coasts and of the whole western plateau, as well as those of the New South Wales coast, have paternal descent and use womerahs. It is very difficult to decide which of the two latter groups is the earlier. Graebner links the womerah-users and clans using paternal descent with the West Papuans; and the maternal clans with the less primitive northeastern Melanesians.[23] Usually paternal descent, implying that the father of the child is known, is the latest development (see Fig. 4).

As regards means of navigation, there is a natural progression from southwest to northeast. From Shark Bay to Adelaide there are no boats.

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[21] H. H. Johnston: Note on a paper by E. H. L. Schwarz on "The Origin of the Hereros and Ovambo," *Geogr. Journ.*, Vol. 54, 1919, pp. 49–52.

[22] A. H. Keane: Man Past and Present, rev. edit., Cambridge, 1920, p. 85.

[23] Graebner: Anthropologie, 1913.

Along the northwestern coast are rafts only (as also near Burketown, Q.). In the next zone is the bent-bark canoe of Victoria. Then comes the sewn-bark canoe of Wyndham (W. A.), the Gulf of Carpentaria, and the East Queensland coast. Lastly are the wooden canoes of Darwin and the outrigger canoe of Cape York Peninsula.

The totem in Australia (see Fig. 5a) usually represents an animal, from which the tribe is believed to be descended. The name passes to the next generation either by paternal or maternal descent. The totems are often

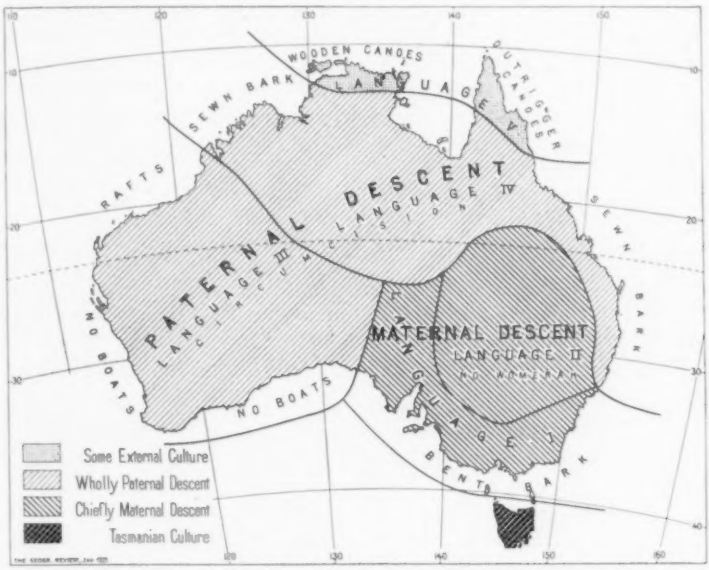

FIG. 4—The chief culture zones in Australia. Social grouping (descent), language, navigation, etc., are the bases of classification (after Sollas, Curr, and Graebner).

arranged in two classes which specifically control the exogamous marriages. Initiation is marked by bull-roarer music, and usually includes knocking out teeth or (in the paternal-descent region) circumcision. Fire ordeals, i.e. kneeling on burning fagots, etc., are common. Belief in magic is universal, while the wizard is credited with being able to suck out illnesses and remove "poison sticks." This latter custom is found in almost all primitive cultures.

After a death the widow besmears her head with pipe clay and wears a chaplet of bones. This is buried in the grave a year later. The Arunta used crouch burial, and other central natives use platform or tree burial. Later the bones are collected. In Melville Island (N. T.) twelve carved grave posts are placed round the grave. It is obvious that many of these primitive customs are found in every continent, which is what one would expect. The important point to notice is that these aborigines have evolved

Another primitive custom which originates in the earlier strata of culture is mummification. This occurs among many of the people using totems, e.g. Dravidians, eastern Australians, tribes of the eastern United States, and through Africa.

The Botocudo

The South American Mousterians, the Botocudo of eastern Brazil, are much nearer to the Australians than to other races. The index is 73–76, the skull is marked by prominent superciliary ridges, by a keel roof, and by a deeply depressed nasal root. The Botocudo have hardly reached the stone age. The women seem to be constantly subjected to barbarous treatment, being scarred and gashed as were some of the eastern Australians. The dwellings of the people are formed merely of branches stuck in the ground and accommodate two or more families. They sleep without any covering and often in the ashes of their fires. The chief differences are in that very variable factor, the color of the skin, and in the lack of hair. The latter may have originated through depilation perhaps assisted by sexual selection.

The Dravidians

The Dravidians of India have been preserved from the stagnation of Australia by the stimulus of repeated invasion. Only a few hill tribes in southern India are so low in the cephalic scale as the Australians, e.g. Badaga and Sholaga (72), the Toda (74) of the Nilghiri Hills, and the Veddah of Ceylon. These Kolarian folk possessed the boomerang, and it seems probable that the very ancient Egyptians, with about the same index (73), used it also (see Fig. 5g). The languages of southern India and Australia are both agglutinative with many suffixes. The curly and abundant hair of the Australian is only paralleled by the allied Todas of India and by the Ainu of Japan, who are slightly higher in the scale.

In group marriages and the allotment of temporary wives at initiation festivals almost exactly the same observances are followed among the Victorian aboriginals as among the Nairs of the Malabar coast of India.

In India and the vicinity we get a continuous series of folk leading from the Sholaga (72) and Veddah (72) up through the other Dravidians (74), the Hindu of Bihar (75), the Santals (76), the Nagas (77), the Kurds (78), the Tates of Caucasia (79), the Baluchi (80), the Parsis (82), the Tajiks (84), and the Galchas (85). This in itself indicates that the center of dispersion was close to India, for nowhere else in the world do we get such a continuous series. Indeed we know that all these folk moved south or southeast, so that their center of dispersion must have been somewhere between the Caspian and Tibet.

Zone IV, Customs of the Folk of the Hamitic Migration

As we progress inwards from the Negro belt we reach migration zones which have moved away later from the original home and which have been

less broken by the vicissitudes of history. It might seem at first absurd to correlate such diverse folk as the following: Hottentots, Copts, Etruscans, Portuguese, Punjabi, Igorots, Moriori, Micronesians, Hurons, Seri, and Yahgans. Yet there is strong evidence of common origin when their geographical position among the migration zones is compared with their anatomy and with their customs and languages.

In the first place all have a head index close to 76 and have regular features recalling the well-known "Dago" or gypsy type. In every case they lie outside a belt of people with Aryan affinities, and there is often a belt of negroid folk on their outer margin. They are nearly all characterized by a belief in such extraordinary customs as the couvade—in fact the "couvade horizon" is one of the most definite of the ethnological strata (see Fig. 5b).

The Couvade and Its Distribution

The world-wide distribution of the couvade, i.e. the custom of a father abstaining from certain foods and practices and at times from all exertion whatever for some days or weeks after his wife has borne a child, has been known since classical times. It has been customary to ascribe it to a kind of paternal forethought for the welfare of the child which has arisen *independently* all over the world. But this theory cannot be accepted when its relation to the Hamitic migration zone is demonstrated.

The couvade is recorded by old writers as occurring among the most primitive folk in Europe, the Basques, among the Cantabrians, Iberians, and Corsicans (Diodorus).[26] All of these have a cephalic index of 76 and belong to the later tribes of the Hamitic-Iberians. Traces of it also occur in several English counties. We hear of it among the ancient Libyans (75) of Egypt. It is found among the Telugu (Telingas) (75) of Madras and in the Nicobar Isles. It occurs right through the Malay islands, as with the Juhuns of Malacca, the Alfuros (76) of Molucca, in Timor Laut, in Amboyna, among the Igorots (76) of Luzon, in Borneo, and in New Britain (76). In the Solomons and New Hebrides Codrington[27] shows that the couvade is found in San Cristoval, Banks Island, Leper Island, and Pentecost Island. This is along the isocephalic line—isokeph—75–76; and here also head-hunting and stonework flourish.

In eastern Asia couvade customs occur among the aborigines of Wei-ning (in Kwei-chau), in upper Assam, among the Miao-tse of southern China, and among the Ainu (76) of northern Japan. In America it occurs among some of the Eskimos (76) and the more primitive Californian tribes (76). Traces are found among the equally primitive Yuchi tribes (76). In South America it is especially prevalent. In Guiana the husband takes to his bed for weeks,[28] and the custom is found in one form or another among most

[26] H. L. Roth: On the Signification of Couvade, *Journ. Anthropol. Inst.*, Vol. 22, 1893, pp. 204–243; reference on p. 206.

[27] R. H. Codrington: The Melanesians: Studies in their Anthropology and Folk-lore, Oxford, 1891, p. 228

[28] E. F. im Thurn: Among the Indians of Guiana, London, 1883, p. 218.

of the Arawak and Tapuyo tribes of Brazil. It occurs also in the less advanced races along the western coast, which thus resemble the Californian tribes in this respect as in so many others.

This couvade horizon, as it may be termed in accord with geological phraseology, is to my mind sufficient in itself to prove the vast importance of the cephalic index as a clue to human evolution. Ling Roth gives a few other examples of tribes practicing the couvade which I am not able to identify, e.g. Zandardan (of Marco Polo), Tibareni (of Pontus), and Cassangi (of Congo); but I suspect that their indices are near 75. As regards every example which I can verify the couvade occurs in the Hamitic-Iberian zone *and nowhere else* (see Fig. 5b). Nor does this system stand alone, though it is perhaps the most readily identified.

The Serpent and Sun Cult

The great serpent cult is of world-wide distribution; and, though it spreads in some form or another throughout later heathen races, it seems to have originated with the Hamitic peoples. The Nagas of the northern Punjab still preserve the worship, which long preceded the Aryan religions of India[29] (see Fig. 5c).

The ancient higher Dravidians of northern India (Asura) had cities and a high civilization before the Aryan invasion, just as had the Iberians in Greece and Italy. They were skilled in astronomy and navigation. The cobra (Naga) was the chief object of their worship, while the sun was also venerated. The sacred scourge and the cobra are identical on the Naga gods and on Osiris of ancient Egypt. Both are seen in the insignia of the priests of the highest American civilizations.[30] This serpent cult is found in a debased form in Kathiawar and in southern India. Kindred religions were carried from India to Java in the seventh century before Christ, and probably the ancient Elamites and the Abyssinians had much the same cult.

The great Yoruba civilization investigated by Frobenius[31] is of this epoch and without doubt represents the lost land of Atlantis.[32] It was founded long before Phoenician times by colonists of the Etruscan race. The statues dug up at the mouth of the Niger are of the same type as the heads from Sardinia. The voyages of Hanno and Necho were the last efforts to follow the old sea route. Desiccation had previously ruined the land routes across the Sahara; but the oil palm, banana, pepper, indigo, bronze, and strange buildings of Yoruba can clearly be identified in Plato's

[29] C. F. Oldham: The Sun and the Serpent, London, 1905.

[30] See the cap on the chief priest and his "sungal" scourge in the illustration of a Chama vase, *Bur. of Amer. Ethnology Bull. 28*, Washington, D. C., 1904, p. 638.

[31] Leo Frobenius: The Voice of Africa: Being an Account of the Travels of the German Inner African Exploration Expedition in the Years 1910–1912, 2 vols., London, 1913 (translation of the German "Und Afrika sprach . . . ," Berlin, 1913).

[32] The destruction of Atlantis and the deluge myths may refer to the drowning of the coasts of the deep Mediterranean Basin when the land bridge of Gibraltar broke through (see Fig. G. Pl. I.)

account of Atlantis. The Yoruba and Vei tribes have a head index of 76 like all the other Iberian and Etruscan peoples.

The Mycenaean and Etruscan civilizations are so well known that it is unnecessary for me to dwell on their features. The Basques are an interesting relic of Iberian times in that they alone in all Europe have preserved their Iberian language almost intact. In fact it seems certain that there has been a sort of *retrogression* here; for, though most of the Spanish Basques have a head index of 76–78, the language has spread into some of the Alpine Cevenole (83) villages in France. Probably they made common cause against the invading Franks in the far past. I have met with no other example of retrogression that is quite so striking, but doubtless the same phenomenon has affected many minor races. The alliance of Basque with the other Iberian languages of Berber and Libyan is now universally allowed.

If we admit an advanced Iberian civilization in Egypt in 8000 B. C., then in my opinion we should not be surprised to find that much earlier Iberian migrations carried the great part of their cult with them to America perhaps twenty or thirty thousand years ago. No doubt many of the earliest monuments of Egypt and America were constructed of wood and have long ago disappeared. The power to work in granite and other hard materials was but slowly developed. It is possible that these perishable monuments date back to the common Asiatic breeding place, and that in some such fashion may be explained the extraordinary similarity in structure and detail which occurs in the architecture of Yucatan and of Cambodia. The ritual is of course more easily distributed than the architectural skill. We may compare the snake dances of the Hopi and the ritual of Peru with the snake cult of northern India. There is little doubt that the sacred dragon of China, the serpent of Aesculapius, and even the serpent in Eden are developments of the serpent cult of northern India among much higher races than the originators.

Zone V, The Nordic Migration

Immediately succeeding the typical Iberians come the Nordic races. Sergi classes them with the Iberians, while some German ethnologists unite them with the Teuton Aryan peoples. They have larger frames and are usually fairer than the Iberians. They are usually characterized by long, curly hair and flowing beards. In many places we get a merging with true Iberian peoples.

The Druids and Vikings are popular types belonging to the Nordic peoples. The Kabyles, Santals, Ladakhi, Pathans, and Ainu seem to have many features in common besides their cephalic indices. It may be that the Seri of California[33] and many of the Iroquois peoples were originally

[33] McGee states that the outcast Seri called Kolusio "shaved regularly and might apparently have grown moderately stiff but straggling mustaches and beard" (W. J. McGee: The Seri Indians, *17th Ann. Rept. Bur. of Amer. Ethnology*, Washington, D. C., 1898, pp. 1–344).

hairy but have lost this covering through sexual selection or even partly through constant depilation.

Monoliths and Tattooing

Monolithic monuments and tattooing are characteristic of most of the folk on the border line of the Iberian and Aryan zones. Naturally monolithic monuments like Stonehenge are better preserved than the tattooing of our ancestors, but both indicate that the early Britons (76) were akin to the Nordic folk. Monoliths occur throughout western Europe, in eastern and southern Russia, around the Caspian Sea, the Mediterranean Sea, and the Red Sea. They are very common near the Persian Gulf, throughout the Deccan, in Farther India, in Japan, and in much of China. They have been erected throughout Micronesia and Polynesia even to Easter Island. They are especially prevalent in Mexico and Central America, and perhaps the most striking of all are near Titicaca in the central Andes.

It has recently been shown that Melanesians (77) (akin to the Moriori, Caroline, and Solomon Islanders) built the famous Easter Island monuments.[34] Exactly similar heads have been described from Yap in Micronesia where also occur walled tombs like those found in many parts of the Old World.[35]

We know that the Melanesians of New Guinea make long voyages in their huge canoes from Moresby, and no doubt the Easter Islanders did the same long before the Polynesian (83) migrations invaded the islands and wiped them out. Possibly these islands had a more bracing climate in the early days, which incited the natives to build monuments that the languid Polynesian of today has no desire to rival or copy. It may well be that here again we have evidence of the deterioration in climate of our warm temperate regions.

As regards tattooing it has apparently developed slightly later. Of course the custom has died hard; gypsies, sailors, and the lower white classes generally still keep up this habit. Many of them are indeed direct descendants of the folk who tattooed in prehistoric times (see Fig. 5d).

The Japanese (78), Igorot (76), Marquesan (78), and Maori (78) are perhaps the chief exponents of the art. It also occurs in America among the Western Eskimo (78), Haida, Caddoan (Wichita), Kiowa, Sioux (Omaha and Osage), and Chippewa (Ojibwa), as well as among the cognate Carib and Arawak tribes in South America. The Hupa women of California (79?) were marked with two signs on the chin in just the same fashion as the

[34] For recent discussions of the problem see Scoresby Routledge: Easter Island, *Geogr. Journ.*, Vol. 49, 1917, pp. 321–349; and Mrs. Scoresby Routledge: The Mystery of Easter Island, London, 1919.

[35] F. W. Christian: The Caroline Islands, New York, 1899.

Maoris (78). All these tribes have indices from 78 to 81, and we may notice that the Haida of British Columbia use linear tattoo marks which Christian compares with those of the Marquesan Polynesians.[36]

Semitic and Early Aryan Customs

No myth has received greater support than that of the Lost Ten Tribes. As explained previously, there is much truth in the idea if we realize that the Jews are a very small section of a huge migration dating back for say 50,000 years. Allies of the Jews are found all round the world. The hooked nose recurs in Africa and Melanesia. In some of the northern Solomons, about one man in five has this pronounced feature, and here they are generally known as the "Black Jews" (77). They are more industrious than the Samoans (80–82), and the writer has seen them in Upolu (Samoa) where they are employed on the coconut plantations.

The Syrian Jews were a very advanced race, in fact in their moral and religious beliefs they seem to have eclipsed every race at the dawn of history. But their confrères of Africa and Melanesia have no such high civilization, though many of the customs are similar. Many of the primitive Aryans seem to have been characterized by premarriage communism.[37] Thus the Nagas, Boros, and other tribes of Assam build communal barracks (morongs) for the youth of both sexes. As a result, juvenile chastity is unknown. Tattooing and head-hunting are common, and these tribes often live in pile dwellings. The morongs, jew's-harp, and other features are found in Formosa, Borneo, the Solomon Isles, New Britain; among the Gonds, Kols, Oraons, and Santals of India; and also among the Masai (see Fig. 5e).

To this zone belong the Goidels (Scotch Highlanders), and the description of some of the Assamese and Burmese might almost fit the Highlanders (76). The Khyengs (76) of Burma[38] have a respect for pedigree, and blood revenge is a duty. They are fond of strong drink, are very hospitable, are afraid of the evil eye, have a very clannish feeling, and are notably closefisted. The allied Nagas[39] go further, for they wear a clan tartan and amuse themselves by putting the stone. The tartan kilt also recurs among the Dusuns of Borneo. The Erromangans of the New Hebrides have many customs like the Gaels, e.g. ring stones, keening, funeral feasts, wind-making, etc.[40] The Seri (76) of California[41] have a form of temporary marriage which is only found elsewhere in the ancient handfasting of the Scotch. They keen at the death of a friend as do all the Gaels (see Fig. 5e).

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[36] F. W. Christian: Eastern Pacific Lands, Tahiti and the Marquesas Islands, London, 1910.

[37] S. E. Peal: On the "Morong" as Possibly a Relic of Pre-Marriage Communism, *Journ. Anthropol. Inst.*, Vol. 22, 1893, pp. 244–261.

[38] Keane: Man Past and Present, rev. edit., Cambridge, 1920, p. 184.

[39] W. Crooke: Natives of Northern India (Series: The Native Races of the British Empire), London, 1907, p. 48.

[40] H. A. Robertson: Erromanga, the Martyr Isle, New York, 1902.

[41] McGee, *op. cit.*

The Evidence of Kin Words

A very useful branch of ethnology deals with the terms of relationship used by the various peoples. Thus the Semitic and Arabic tribes use descriptive kin words[42] which are also in vogue among Persians, Armenians, Gaels, Scandinavians, and those Africans who are affected by Moslemism (see Fig. 5f). Most of these are close to the Semitic zone of 76–77.

The Hawaiian type of relationship tends to class all the relations of one generation as similarly akin to the person speaking. Hence all the uncles are called "father" while the nieces are usually "daughter." This is called "unforked kinship" and is found among somewhat higher peoples, i.e. Hawaiian (79?), Karens of Burma (78), Japanese (78), Yoruba (76), Tupi (79), and Arawak (78). The other chief system is called the Dakota or "forked kinship." All near relatives connected to the person speaking *through his father* have this fact indicated, and another sign shows the mother relation. This scheme occurs among the Dakota, Sioux, Chippewa, Tlingit (82), Haida (82), Hopi (83), and amid the Chibcha (81), Sipibo (of the Ucayali), and Araucanians (84?) of South America. It also seems to be present among the Gilyaks (86?) of Manchuria. There is also a queer similarity between the kin words of the Tamil (76), Toda (74), and American Seneca (75?), which seems to show an earlier "horizon" of "forked" kin words, but Lowie is doubtful of their connections.

Folklore

The folklore of these Aryan folk has the same basis all over the world. Thus the Micmacs (76) of New York had an evil spirit Lox (the wolverine) which acted just like the Loki of the old Norse (76) legends. The Algonquian Miamis (76?) held séances in which astral bells and winds were made manifest just as in Britain today. The Muskogee stories are described as coming straight from the Old Testament. The Catawbas have fire dances which recall those of the Sabines.

The belief in a virgin birth, in a personal God, and in a future Messiah is prevalent among many of these tribes, e.g. among the Karens of Burma as well as the Jews. The werewolf myths are also ubiquitous, with the natural change to a more familiar animal. Thus we get the werewolf in France, the weretiger in Perak, the werejaguar in the Amazons and the wereleopard in Africa. The myth of Persephone is current in Japan and in New Zealand. The story of Jason is almost world-wide.

The swan-maiden fairy tale[43]—in which the hero sees a number of birds descend from the sky and change into maidens—is universal in or near the Aryan zone. In almost all the stories the birds bathe, and the hero steals either clothes or feathers and so wins a wife. This tale occurs throughout

[42] R. H. Lowie (Culture and Ethnology, New York, 1917) discusses Morgan's data, but neither writer correlates them with head form. See also Lowie: Primitive Society, New York, 1920.

[43] E. S. Hartland: The Science of Fairy Tales, New York, 1911.

Europe, among the Santals of India, Annamese, Kurds, Burmese, Japanese, Melanesians, Arawaks, and Algonquians.

Correlations in Material Culture

Tools and weapons are often useful guides. Thus the blowgun is found only among the lower Amerinds with an index of 76 or so, e.g. the Iroquois, the Antilleans, and the Jokuns of Brazil. It also occurs among the Malay people of the same zone. The sling bow occurs only in Malay and in the Amazons. Bark-beaters for making cloth occur among the Polynesians and their kinsmen in America. Even tobacco helps us to correlate North and South America. The elbow pipe is found among the more primitive folk in the east of each continent. The cigar is more characteristic of the plateaus and Carib country, where the tribes have a higher index.

The Higher Aryans—Alpines, etc.

It is perhaps well to pause for a moment to consider the composition of the races of Europe today (see Fig. 6). The old ethnological stocks still remain fairly distinct in spite of wars, conquests, and treaties. Nationality is in a basic sense more a question of physical anthropology than most historians would have us believe, though for reasons which I have explained in my earlier paper I am not disposed to place so much stress on stature and color as do many ethnologists.

The Peoples of Europe

There appear to be in Europe representatives of peoples from Africa and from Asia. Of the former we have (1) the old Iberians and (2) many Nordics (see Sergi). From Asia we have probably many Brython and Teuton races, not unlike the Nordics. These are longheads. There are also Alpine peoples (ancestors of the Keltae), such as the early group which may be termed Savoyard-Illyrian. These are roundheads, as are the Cevenoles and less brachycephalic folk like the Slavs. Later again are the non-Aryan Magyars, Finns, Lapps, and Turko-Mongols, who are numerous only in the north and east. The chief European countries may therefore be subdivided as in Table V.

Table V and the accompanying map (Fig. 6) are, I think, very interesting in view of the recent changes in the map of Europe. The Austrian Empire has been dismembered into the fairly homogeneous groups of Magyar, Austrian, Czecho-Slovak, and Serb-Croat-Slovene nations. The Rumanians have received several millions of similar-speaking people, who are however chiefly of Cevenole origin. They are more nearly allied to the Abruzzi and Provençal than to the Wallachian. We see, however, that France has in the past managed to incorporate several absolutely distinct races, and so has Italy. Germany includes dolichocephalics in the north, the middle Germans are allied to the Slav, while the Swabians are very brachycephalic Alpines.

It may be objected that though the Slavs have the same head form as the

FIG. 6—Map showing the correlation of the component nations of Europe. Compare with Table V opposite. The broken lines on the map represent linguistic boundaries.

TABLE V—CORRELATION OF THE COMPONENTS OF THE CHIEF NATIONS OF EUROPE (GENERALIZED)

COUNTRY	PRIMITIVE IBERIAN (CEPHALIC INDEX 75–77)	NORDIC AND TEUTON (C.I. 77–80)	DOLICHO-CEPHALIC ALPINE (C.I. 81–85)	BRACHY-CEPHALIC ALPINE (C.I. 85–88)	ASIATIC—NON-ARYAN (C.I. 81–87)
Ireland Scotland	Pict? Goidel?	Goidel? Some Saxons			
Wales England	Pict of Devon	Brython Saxon			
France	Basque Dordogne	Norman Gascon, etc.	Cevenole Frank	Savoyard	
Germany		Prussians Saxons, etc.	Bavarian (Austrian)	Swabian	
Spain Portugal	Basque Central Spanish Portuguese	Andalusian, etc.	Few Galician		
Norway Sweden	Few in mountains	Bulk of people	Few in S. W. (Finn)		Lapp (87) Finn (81)
Switzerland				Swabian Ladin, etc.	
Italy	Corsican Etruscan	Sardinian Sicilian	Lombard Umbrian	Savoyard Ladin, etc.	
Greece	Pelasgian	Type Greek	Many Slavs	Albanian	Turk (85)
Bohemia Poland			Czech and Pole		
Serbo-Croatia			Many Croats	Croat and Serb	Turk (85)
Hungary		Some Teutons	Magyar of Plains	Magyar of Carpathians	Magyar (largely Alpine now)
Rumania			West Rumanian and Wallachian		
Bulgaria			Bulgar		Turk
Russia		Some Teutons	Lithuanian Slav Pole		Finn (81–82) Cossack (84)

middle Germans, Finns, and Wallachians, yet there are great differences between them. My opinion is that they are all peoples of the same migration zone, who have however arrived in Europe at very different times and have in some cases started off from different areas in Asia. Thus the Germans came from that portion of the zone nearest to Europe, i.e. in or around the Pamirs. Hence their language is Aryan of a somewhat primitive type. The Finns came from a very distant portion of the zone—probably from the Altai region in Siberia—hence their language is strongly affected by the (later-developed) Tungus speech which was originating here. The Slavs are a race who came from an intermediate breeding place. The Magyars probably came at a much later date from the same cradle as the Finns.

Where the isopleths of head form (isocephalic lines) on the map are crowded together, as in central Italy, we get very sharp differences in ethnology. Where they are widespread, as in northern France, it is probable that we have the greatest hybridization occurring. Finally we must bear in mind what may be called the *mass effect* of a people. In central Europe the very brachycephalic people—though ethnologically higher—were on their arrival more primitive than the southern dolichocephalic people and also at first less numerous. Hence we find them dominated by an earlier civilization (the Roman) and modifying their language accordingly.

We see that the same thing has occurred in Bohemia and Serbia. Here the Alpine folk have adopted much of the Slav language and culture. It must not be forgotten that their own tongue was also Aryan and therefore easily swayed either to Latin, German, or Slav speech. This aspect is discussed later.

Finally, if we turn to China we see there an "Alpine" people coming down in vast hordes into a dolichocephalic—one might say Aryan—region. Here the mass effect causes the Mongolian culture to submerge the "Aryan." But ethnological research can readily detect the primitive peoples covered with a Mongolian veneer.

In Figure 6 we see graphically how difficult it is to disentangle the components of the various nations. Almost the only fairly homogeneous race is the Swiss (86–89) who are all Alpines with very round heads. Yet here there are four languages spoken habitually: i.e. German, French, Italian, and Romansh, besides various dialects!

Following Ripley we find the key to lie chiefly in the cephalic index and in the physiography of the region. Speaking generally of the central regions we find that the Teuton on his appearance drove the Alpine up the valleys, while the Slav drove the Teuton up in turn. This is well illustrated in the basins of the Inn and the Adige.

It is an axiom in these studies that scattered peoples confined to mountainous regions are usually relics of an early migration. The habitat of a tribe is determined by its powers of resistance to aggression. In Europe we have a double confusion which is primarily due to migrations coming in from Africa and Asia, possibly simultaneously; while, more unusual still,

there is no doubt that a large number of very broadheaded Alpines preceded some of the longhead Teutons and most of the other Alpine and Slav races. This is contrary to the general rule that migrations occur in the order of the cephalic index, i.e. from longhead to broadhead.

Scattered Peoples in the Mountain Regions of Europe

We find that the most inaccessible regions in Europe, away from the main corridors and among mountains, are universally occupied by very brachycephalic peoples. Among these are the Albanians, West Rumanians, Rhetians, and Savoyards. These tribes have been herded into the hills and disrupted by Teutons, Franks, Lombards, Huns, and Slavs. Only the dark Provençal and Cevenole of slightly lower cephalic index have shared their fate and may belong to the same period of migration. The Spanish folk (78–80) and those of Guyenne (78–80) have most points in common (save color) with the Nordic peoples (78–82) around the Baltic and North Seas. Possibly they are of the same migration, though one section may have arrived by way of Africa, and the other by way of Anatolia or southern Russia. They seem to have driven the broadheads into the coasts or hills, as in the southwest of Norway and in Poitou.

It seems likely that a medium brachycephalic race followed close after them (83–86) and passed along the plains between the Alps and the North Sea. They occupied the woodlands of Germany and Burgundy driving the dolichocephalic Teutons somewhat to the north and west, and it may have been a similar later thrust that caused the Saxon descent on Britain. These Alpine folk sent a long tongue of Bavarians along the Danube valley. Another pressed to the south, probably leaving many tribes in Rumania, and settled in northern Italy, especially in Lombardy and Umbria. A later stage saw the advance of the western Slavs, who occupied Bohemia and Serbia. They were displaced from Hungary by a much later Asiatic migration of Huns. The latter, however, have incorporated so much Aryan (Alpine) blood that, like the Turks, their language is perhaps the chief feature distinguishing them from their neighbors.

The chief feature of later European ethnology is the resistless spread of the Slav peoples. They have swamped all relics of the longheads who used to inhabit their region. They have driven a Polish wedge between the Prussians and Saxons, and a Bulgar and Greek wedge right down into the southeast of Europe. There is little doubt that Slav blood is quite as important as Nordic blood among the Greeks, while the old Pelasgian (Iberian) blood is only found in Attica and Thessaly.

Alpines in Asia

Although the Alpine folk of Europe are an exceedingly important constituent, their numbers are almost negligible compared with their kin who still remain in Asia, mostly to the east of the Aral desert. Here they occupy

almost the whole of Siberia and Manchuria. Among primitive peoples of earlier origin are the Ostyaks of the Yenisei (76), the Altaians (79), and the Dungans of Kulja (in Turkestan) (79). These are dolichocephalics who have been driven to the tundra and up into the mountains by the overwhelming hordes of Alpine folk. Their culture will doubtless be found to resemble that of their kin in Europe, but I have no data available.

Among the more brachycephalic folk (83) are the Paleo-Siberians (Czaplicka) comprising the Chukchi, Yukaghir, Koryak, and perhaps including the Gilyak of Saghalien. Most of these tribes have a similar culture. The family is the chief unit, the elder people rule and often have shaman powers. Blood revenge is obligatory, though sometimes compensation is accepted (Gilyak). Some of the bear festivals of the Gilyaks have customs recalling the Greek Olympic games. Levirate (compulsory marriage with a brother's widow), lack of chastity before marriage, and group marriage recall the customs of the somewhat earlier peoples of the Aryan clans of Assam. Serving sometimes for three years is necessary to procure a wife among the Koryaks, while the myth of Lot is a well-known folk tale among the Chukchi. A mock struggle at the wedding is a development from marriage by capture which characterizes almost all the tribes of Siberia, from these Paleo-Siberians up to the Chinese themselves.

The Tungus

Somewhat later in development is the Tungus group of people (84–85), who are allied to the Finns and Turks in language and also resemble the Manchus in certain particulars. They have many of the characters of the typical Mongol but are in general more shapely and active with a quick intelligent expression. "All observers speak in enthusiastic language of the temperament and moral qualities of the Tunguses. . . 'Full of animation . . . always cheerful even in the deepest misery, holding themselves and others in like respect, of gentle manners and poetic speech, obliging without servility, unaffectedly proud, scorning falsehood, and indifferent to suffering and death—the Tunguses are unquestionably an heroic people'."[44]

The shaman is the most characteristic feature of their culture. He is the leech, soothsayer, and priest. Some shamans are hereditary, some are elected; and they may be either male or female.

Further to the east are other Alpine folk such as the Dauri of the Amur. Allied clans have tall stature, somewhat regular features, brown hair, light eyes, and even a florid complexion. They are met with in Korea, Manchuria, and parts of northern China. I have no data on their customs.

Marriage Customs

The levirate is observed by many races of the Aryan zone. In Asia and Africa a few of the lower races such as the Gonds and Semites, the

[44] Élisée Reclus: Nouvelle géographie universelle, Paris, 1881, Vol. 6, p. 712.

Gallas, and some of the Zulu and allied tribes also conform. Generally speaking, however, the custom is confined to races between the isokephs of 78–80. Westermarck gives the following tribes: in America, the Kwakiutl, Tlingit, Oregon, and Miwok (Moquelumnan family) of the western coast, the Wyandot (Huron), Chippewa, and Shawnee, the Aztec and Maya, the Arawak, Tupi, and Warrau; in Oceania, the Samoans, New Caledonians, New Britain and Caroline islanders, and many Malay tribes; in Asia, the Ossetes and Kurds in the southwest (see Fig. 5h).[45]

All these races have relics of marriage by capture, usually taking the form of a mock struggle. But it is significant that Westermarck remarks of the Chinese, "Of capture of wives there is no trace, not even among any of the ceremonies." The ancient Teutons and Slavs really *captured* their wives while among the western Slavs the custom persisted till the last few hundred years; but, though we may be sure that the earliest Chinese also had the same practice, their culture and development have progressed so far that no memory of it persists.

Marriage and social organization in North America have been studied in some detail and agree to some extent with the isocephalic lines. We find that in the Huron tribes (73, etc.) the primitive matriarchate obtained, as in southeastern Australia. Most of the eastern tribes (75–78) had strong exogamous rules. Among the lower Pacific coast tribes (78–80) the clan disappears, and real purchase of brides occurs just as it did among the Romans and Teutons. The Kwakiutl and allied tribes also purchased their wives. The Pueblo Indians (80) are monogamists, and the status of women is higher than in most tribes. The wife may dismiss her husband on a slight pretext. Other social features were more primitive.

Late Aryan and Alpine Peoples in America

Owing to the enormous distance between Europe and America (via Asia) we cannot hope for very exact correlation between tribes on similar migration zones. Moreover, mixing and hybridization became much more general as the earth became fuller. Few of the Americans, for instance, retain the well-developed hair and beard of the typical Alpine.

A number of customs have a world-wide distribution along the belt of 79–84 which we are now considering.

Head Deformation

Traces of this weird custom are found in the Caucasus (ancient Cimmerians), in the Crimea, in Hungary, Silesia, Belgium, in France and French Switzerland, especially in parts of the Pyrenees and the French Jura. In Asia it is, or was, common among the Turkomans (83). In Tahiti (78–84) it is very marked. America, however, is the classic country of

[45] E. A. Westermarck: The History of Human Marriage, London, 1891.

head deformation. In North America intentional deformation is found among the Natchez and the allied Muskogean tribes (82). It exists more or less from the Columbia River (Salish and Chinook, 80) down the coast to Peru. It is characteristic of the Maya (83) and Toltec people and the tribes of the West Indies (83). It is stated to be difficult to distinguish certain flattened skulls of the Crimea from those of Aymará of Peru.[46]

The use of the vapor bath spreads from Lapland through Siberia and down the northwestern coast of North America. The religions of all these brachycephalic peoples (80–85) are similar. The belief in shamans and the use of magic and jugglery in sickness are universal. Blood revenge, political organization, carved houses, mortuary columns, and other features are common to two such widely separated brachycephalic tribes as the Haida of British Columbia (82) and Polynesians of the same head form.

Ritual and the Zodiac

Holmes has noted a remarkable similarity between the architecture of Cambodia (82) and Yucatan (83). The temple pyramids in both cases are approached by four stairs with serpent balustrades. The altars are similar. There are even similar dwarf Atlantean figures supporting the doors, and some of the figures show whiskered men.[47]

Even more remarkable is the identity of the signs of the zodiac in Asia and in Peru. The ram becomes the llama, the bull is the stag, the twins are man and woman, the crab is the octopus, the lion is a puma, the virgin is the maize mother, the scales are forks, and the bowman is an arrow, etc. The Maya signs are similar though not identical.

It is not yet possible to show all the stages in the migration, but that the eastern Alpine folk (82) passed to America, probably via the Bering Corridor, can hardly be doubted. Possibly this passage occurred in the Azilian period when, as we know, their more primitive kin invaded Europe.

The general trend of the isocephalic lines seems to show that all the tribes came in from the northwestern corner. It is difficult to conceive how any direct migration from Europe can have taken place. The climatic features have been adverse, and no land bridge has existed during Pleistocene times. There is no doubt that surges from the eastern coast of America towards the west have occurred, but these were only ephemeral and of little importance in the grand problem. In America as elsewhere the most highly developed culture is not, however, usually associated with the most extreme brachycephalism.

In the northern continent the Mayas, Aztecs, and Pueblo Indians had advanced farthest on the path of progress. Their head index is about 82, whereas that of the Plains Indians of the central Mississippi rose to 88

[46] Paul Topinard: Anthropology, London, 1890; p. 179.

[47] W. H. Holmes: Bearing of Archeological Evidence on the Place of Origin and on the Question of the Unity or Plurality of the American Race. *Amer. Anthropologist*, Vol. 14 (N. S.), 1912, pp. 30–36; reference on p. 35.

(see Fig. 2). In the same way in South America there were four great civilizations, Inca, Aymará, Chibcha, and Calchaqui. I am not able to get satisfactory coefficients; but these also would appear to be about 83, while the unprogressive Araucanians of the far south are 86 and some of the Bolivian Indians 88.

It is noteworthy that the very high indices occur only in three or four isolated districts in America and do not form a large compact group as in Central Asia. These American districts are so far distant from Asia and so disrupted that one wonders if these forms have developed *in situ*, perhaps under stimuli of drought, competition, and elevation such as I postulated in Central Asia. This problem can only be solved locally.

The tribes of America have in general been classified linguistically (see Fig. 2). Nothing else is possible at present, but a scheme which groups Alaskans (84) with Déné tribes (77), or groups Algonquians of various stocks from 78 to 71 or Aleuts (79) with Greenlanders (74) does not appear to the writer to be either genetic or final. Great language *transgressions* have certainly occurred in America as in Europe. The *dominant* race (whether dolichocephalic or brachycephalic) has impressed its speech on the weaker race, but without altering the other cultural features to a corresponding degree. We may hope that in the future the American zones may be disentangled and correlated with the better known races of the Old World.

The Tibeto-Chinese Group

In many respects the Chinese, who are the dominant members of this group, are worthy of the highest respect. Their Empire has remained virtually continuous for 5,000 years, in fact since the dawn of history. With each century more and more of the surrounding tribes have become amalgamated with it, and it is for this reason that it is the great rival of white dominance. The Empires of Elam, Egypt, Babylon, Persia, Macedon, Rome, and Spain have waxed and waned, and their peoples have become scattered and almost negligible, yet the millions of China still remain consolidated and ready for the awakening that is coming. This is of course due largely to their environment remaining much more favorable than in the other empires.

At almost any period anterior to the last hundred years the Chinese held a worthy place among the nations, so that none should blame them if they condemn the arrogance of the upstart nations of today. Their Empire is so huge and populous that we must first ascertain where the typical Chinese folk dwell. Even when they dwelt in the Tarim Basin the old legends indicate that written characters had superseded the knotted cords (compare the quipu of the Incas) for the purpose of keeping records. The matriarchate had died out, marriage was instituted, and musical instruments were invented. Astronomy and silk weaving were practiced. All this is placed anterior to 2600 B. C. in the earliest Chinese histories.

About 2600 B. C. they migrated through the "Jade Gate" into the upper Hwang Ho basin, and for 2,000 years their capital was in Shensi. There are in existence bronze bowls dating from 2000 B. C., and a large number of beautiful works of art in jade date back to 1000 B. C. Their culture seems to have equaled that of any of the occidental empires. About 800 B. C. the phonetic seal writing was invented, and about 550 B. C. lived two of the world's greatest religious teachers, Confucius and Lao-tse, while Mencius was 200 years later. The Great Wall was built before 200 B. C.

About 120 B. C. their Empire extended to Yunnan. In 30 A. D. the capital was moved eastward into Honan and in 1264 A. D. to Peking by the Mongol Kublai Khan. Marco Polo's record deals with this period when the Mongols and Chinese conquered half the known world. Jenghis Khan and Tamerlane are two other emperors of the thirteenth century who made the Mongol power dreaded by every other nation.

The highest Chinese type is probably still to be found in the northwest along the valley of the Hwang Ho. Data as to the head form of the peoples of Central Asia are not available. Ripley shows a solid block of very brachycephalic tribes (over 88) extending from the Himalayas to Lake Baikal.[48] All this region is now very inhospitable and sparsely inhabited, but these conditions have only supervened within the last few thousand years.

The Aurignacian Belt of Low Stature

It seems likely that there was a large population of short Aurignacian peoples in southeastern China, who resembled the modern Eskimo. Hence in this portion of China, which is the chief source of the well-known Chinese coolie, we find squat figures, dark skin, and high cheek bones, which are less common in the regions of higher cephalic index of Tibet and northwestern China (see Fig. 7).

The same short uncouth figure is found round the periphery of the true Mongolian region and seems to be identifiable in Deniker's tables of stature. Thus it occurs among the Lapps (152 centimeters), Samoyedes (155), Chukchi (165), low-class Japanese (157), southern Chinese (161), Annamese (157), and especially in the Mongolians from Burma to Timor (158). All these peoples are near the Aurignacian migration zone of 74–75. We find other races in this zone with the squat figure, as among the Fuegians (157) and some Tupi-Guaraní (157–160) of Brazil. It is of course a feature of the Aurignacians of South Africa—the Bushmen (153). The same zone in Spain gives us Moors (162), Portuguese (163), Corsicans (162), and some primitive French folk. Lastly it is general throughout southern India among the Dravidian folk, i. e. Kurumba (155) and Chota Nagpur tribes.

Early Mongol Civilization

I suggest therefore that some of the accepted salient features of the Mongolian are relics of a very much earlier migration. In effect they show

[48] Ripley, *op. cit.*, p. 42.

the hard conditions which the original Aurignacian suffered in his fight against the inclement environment of the Ice Ages. These features are not found so generally among the Mongolians who determined the wonderful Chinese civilization of the centuries.

There seems little doubt that the earliest civilization was developed by the Proto-Mongols, possibly in Turkestan. They were connected with the Sumerians of southwestern Persia and with the peoples of Askabad. Indeed Turkestan is now the only flourishing region which still remains in spite of the secular desiccation which has ruined every country round it.

We find a common tradition among the Chinese and the Akkadians, who were the successors of the Sumerians. Thus the Babylonian priest Berosus (third century before Christ) describes the earliest dynasty as consisting of ten kings and enduring 432,000 years. This is exactly the same as the Chinese story. The Sumerian art, town life, and religious ideas are also said to be closely akin to those of the Chinese. At Susa (Persia) we get artifacts showing a very high civilization at a depth of 50 feet below the surface. They are estimated to date back 14,000 years. At Askabad in Turkestan are similar relics which greatly antedate the Egyptian civilization.

FIG. 7—The Aurignacian zone of low stature. Compare with zone 74 (cephalic index), Fig. G, Pl. I.

The Chinese many hundred years ago had evolved a civilization to which we are only now attaining. As A. H. Smith wrote, they are characterized by "a love of industry, peace, and social order, by a matchless patience under wrongs beyond cure, by a happy temperament, by no nerves, and a digestion like an ostrich!" These are pre-eminently the traits which are needed in the workaday world of today. When we realize that the Chinese have natural resources at their disposal which are unrivaled (except in North America), it is obvious that only unremitting diligence, thrift, and sobriety will enable the white man to resist the "yellow peril." This is not a peril of military invasion, such as that by the Huns of old, but an economic peril for which I see few nations of the world educating themselves.

It is often objected that the Chinese are decadent because they have lagged behind in the race. To my mind this is merely a question of wrong education. The World War was largely due to a wrong education which resulted within forty years in the Germans glorifying military aggression. The stagnation of the Chinese was due to a sort of "Yellow China" policy, not very remote from "White Australia" policy. But this is now being abandoned throughout China. We shall see in the next fifty years a new China which will dwarf the old régime just as New Japan, the Britain of the Orient, far surpasses the ancient Empire of the Mikado.

Part V

Environment and Civilization

The foregoing sections aim to demonstrate that civilization is almost wholly a question of environment, at least since the dawn of true civilization in Asia. Table VI shows the ethnology, climatic control (temperature), and date of some of the chief civilizations. From this table we see that excluding the lowest races (75 and under) most of the races have been pre-eminent at

TABLE VI—THE RISE AND FALL OF CIVILIZATIONS
(GENERALIZED)

APPROXIMATE DATE	NATION	ZONE	CEPHALIC INDEX	TEMPERATURE	
				SUGGESTED ANCIENT	PRESENT
B.C. 10000?	Proto-Mongol	Early Mongol*	83?	65°F.	60°F.
8000	Sumerian	Early Mongol	83?	74°	78°
6000	Akkadian	Semitic	77	74°	78°
5000	Egyptian	Iberian	76	65°	70°
4000	Chinese (in Northwestern China)	Early Mongol	85	55°	50°
2000	Hittite	Alpine?	83	58°	60°
2000	Persian	Aryan	77	68°	70°
1000	Etruscan	Iberian	76	63°	65°
300	Macedonian	Alpine	81	63°	65°
A.D. 0	Roman	Alpine?	81–83	60°	62°
1100	Saracenic	Alpine and Semitic	?	68°	70°
1500	Spanish	Aryan	79	About 2000 B.C. 58°	60°
1800	French	Alpine largely	80–83	About 2000 B.C. 52°	55°
1900	British	Aryan	79	About 2000 B.C. 46°	50°
2000	U. S. A.	Aryan	79	About 2000 B.C. 46°	50°

* Early Mongol and Alpine races are variants in the same zone.

one time or another. In America the Maya (700 A. D.), Aztec (1200 A. D.), and Inca (1500 A. D.) also flourished and had their day.

The races with cephalic index above 85 do not appear to have attained eminence. In Europe they have formed considerable but not preponderating proportions in the Roman and French empires. Probably they show their chief merit in the arts, for many of the most famous poets, artists, and men of intellect generally are Alpines from South Germany, Switzerland, and northern Italy. This in my opinion is the highest type living in Europe, and under forthcoming settled conditions we may also expect great things from the western Slav races who are of much the same strain (see Fig. 6).

Furthermore we have seen that it is something very like accident which has determined whether a race shall migrate from Asia to a region of

stimulating climate and bountiful resources like Britain or to the hot enervating Malayan jungles or to the dreary cold of Tierra del Fuego.

What has caused the rise of a race and its decay some thousand years later? Huntington believes that it is very largely a question of climatic change. I do not propose to go deeply into this question but only to discuss the Table VI and the map which is given as Figure H, Pl. I.

If we glance at the temperatures of the ancient civilized lands we see that, speaking generally, the modern civilizations are in cool moist climates, while the sites of the ancient civilizations are nearly all either arid or hot or both.

On a map of the world let us insert the isotherms, not, as usually shown, reduced to sea level, but as they actually exist, modified by elevation (Fig. H, Pl. I). We find that the centers of advanced civilization occur very close to the "actual" isotherm of 50°F., and this is the case in both hemispheres. Thus in the south we have Buenos Aires, Valparaiso, Durban, Melbourne, and Wellington, N. Z. In the north are Seattle, Chicago, New York, London, Paris, Berlin, Peking, and Tokyo. Winnipeg, Montreal, and Petrograd are almost the only large centers on the isotherm of 40°.

Now let us look at the "actual" isotherm of 60°. Here or near are many large cities, which in times past have been of imperial rank, Rome, Athens, Samarcand, and Nanking. We know that they were the centers of flourishing nations one or two thousand years ago. If we take the "actual" isotherm of 70° we find it passes through Egypt, Mesopotamia, the Indus Valley, Cambodia, inland Ceylon and Java, and the Maya region of Yucatan. Most of these were centers of civilization in prehistoric times, about 2000–4000 B. C.

Poleward Movement of Civilization

Speaking generally we may say that the belts of *civilization* move poleward. I have shown in my earlier paper (Climatic Cycles, 1919) that the *isotherms* and *desert belts* are moving poleward as the earth heats up after the Ice Age. We can hardly escape the conclusion that our boasted civilization, like our ethnological status, is determined by changes in temperature and rainfall.

It is unnecessary to describe the evidence from which we know that the climates have altered within the last 3,000 years. Huntington has dealt with it very fully in various notable books. Hobbs gives a most interesting account of the extraordinary change in the Nile Valley and especially in the Kharga Oasis. "For a period of at least twelve years no rain has fallen in the inhabited portion of the depression. There is, none the less, abundant evidence that in earlier times the region was more favored by climate and supported a large population." Heavy deposits of tufa enclosing leaves of oak are found in the Wadi Refuf near by.[49] The writer has examined exactly the same type of deposits in the steep gullies of the Flinders Range

[49] W. H. Hobbs: A Pilgrimage in Northeastern Africa, with Studies of Desert Conditions, *Geogr. Rev.*, Vol. 3, 1917, pp. 337–355; reference on p. 353.

(Depot Glen) in South Australia, where, in a similar latitude, the desert is also creeping polewards into the less arid regions.

The climatic stimulus has been more marked near the cradle of mankind than anywhere in the world, and we have to thank this factor for the evolution of man from the *Pithecanthropus*.

We may separate the regions of Tibet and northwestern China from the remainder in Table VI. Here the temperature has probably fallen somewhat, owing to uplift, but the aridity is the controlling factor. This is a rain-shadow desert and so is not affected to such an extent by the secular swing of the climates. In the other regions we see a steady progression from 78° in Persia to 50° in the United States. In the table I have ventured to insert tentative temperatures to indicate the conditions when flourishing civilizations occurred in the localities named. It will be seen, I think, that, although temperatures in the older centers were more comfortable in the past and less comfortable in Britain and northern Europe than now, it is the movement of the desert belts which has chiefly determined the decay of the old empires.

It may be objected that if Scotland were four degrees cooler in 2000 B. C. we should have had a glacial age in the Highlands. I suggest that the corries were deepened considerably even so late as this date, though no moving glaciers were formed.[50] The great importance of late cirque or corrie erosion is not yet fully recognized.

The Zoning of Civilizations

In the map (Fig. H, Pl. I) I have attempted to synchronize the various civilizations. I assume that colossal buildings like those of Boro Budur in Java, Angkor in Cambodia, or the ruins of Titicaca in Bolivia imply many thousands of years settlement before the temples were built. Thus we may perhaps class in the first epoch the Sumerian (and Proto-Mongol?). In the second epoch are the Akkad and Egyptian. In the third epoch are the early Chinese, the Cambodian, the Hittite, and possibly the Maya of Yucatan and Chibcha of Colombia. In the fourth are the Inca and Aymará civilizations of the Andes, the Greek and Roman, and the Toltec. In the fifth are the hill civilizations of Java and Ceylon, Spain, and central India. Finally today we have the sixth epoch with the centers already described. While opinions may differ as to the details of this generalization, yet I think the main principle that civilizations occur in zones must be admitted. One very important conclusion can be drawn from the diagram. If the civilizations grow up in climatic zones, they must be more or less parallel to the equator. We have seen in the early migration maps that the chief corridors are determined by the topography even more than by the desert and forest belts (climatic control.) Let us look at America. Here the migration zones run primarily north and south. Hence they cut

[50] Griffith Taylor: Physiography and Glacial Geology of East Antarctica, *Geogr. Journ.*, Vol. 44, 1914, pp. 365–382, 452–467, 553–571; reference on p. 369.

across the civilization zones, and so we find the anomalies in culture which have made the ethnology so confused. Thus the Alpine tribes who occupied the portion of their special migration zone most favorable for the development of civilization built up the Inca and Aztec cultures, while their blood brothers who were pushed away towards the south remained in a savage state. For the same reason the Yahgans, whose ethnic status was equal to the Etruscans and Gaels, found all their time occupied in searching for food.

In Africa we see the Bantu of the plateaus dominating the Bantu of the coast. In Europe the climatic and ethnic zones are more or less parallel, and the distinction is not so obvious. Yet the ancient Irish Goidel is kin to the civilized Etruscan and Cretan as well as to the savage Todas of India and Nagas of Assam. The Irish tribes inhabited a cold, wet, outlying portion of Europe with the result that right into the Stuart period they were probably the most savage tribes in Europe. To realize this we have only to read the contemporary descriptions by Fynes Moryson (A. D. 1600) or by Spenser and Raleigh. Moryson saw "Young maids stark naked grinding of corn with certain stones to make cakes thereof."[51] Another traveler was regaled by Chief O'Kane in Ulster. "He was met at the door with sixteen women all naked except their loose mantles. . . . Soon after O'Kane, the lord of the country, came in all naked excepting a loose mantle and shoes which he put off as soon as he came in."[52] The Todas wear exactly this type of cloak, as Gomme suggests.

The earlier Irish warrior when he killed his enemy broke his skull, extracted his brains, mixed the mass well, and, working the compound into a ball, carefully dried it in the sun and produced it as a trophy of valor. He carried the heads of the slain at his girdle just as his blood brother does in Malay and elsewhere. In the interments of the Long Barrow period headless trunks are frequently met with, as are also heads buried separately;[53] so that head-hunting was no doubt as prevalent with the early Irish as with the Dyaks.

No Negro tribe has ever reached a high state of civilization. Possibly the most advanced was the Yoruba State on the Niger, but we have seen that this is due to Etruscan influence. This also accounts for their very advanced type of speech. Yet in higher zones it is obvious that all the races have worthy representatives. The Semites (72) at the time of David produced some of the noblest concepts of religion, 500 years before Confucius lived (B. C. 500). The Cretans (75) had a wonderful civilization before the time of Homer. If on the whole the world seems now to be at the feet of the folk of the Aryan zone (76–79) this is due as I have tried to show to many different factors. The future, in my opinion, belongs to the

[51] Fynes Moryson: A History of Ireland from the Year 1599 to 1603, 2 vols., Dublin, 1735; reference in Vol. 2, p. 372, cited by G. L. Gomme: Ethnology in Folklore, London, 1892, p. 178.

[52] Moryson: An Itinerary, 4 vols., London, 1617; reference in Vol. 4, p. 181, cited by Gomme, *op. cit.*, p. 179.

[53] Gomme, *op. cit.*, pp. 146–149.

Alpine races and later to the Chinese unless the white race conquers some of its pet vices.

In conclusion one cannot but realize that, though evolution is governed by fixed laws, these laws have little regard for the individual and not much more for the race. Mighty consequences for good or evil have resulted from what seem to be trivial occurrences in the life of a race, such as the direction of a migration. These appeared of such small importance at the time indeed that the tribe could not possibly have controlled them, and yet one path led to empire and the other to extinction.

Part VI

The Distribution and Evolution of Languages

I have been unable to find any modern geographical treatment of the languages of the world. Too few workers in natural science seem to realize the invaluable help they may bring to research by charting their results—in effect, by using isopleths. In the present paper I have applied the methods used in geology and meteorology with considerable advantage to the studies of evolution and linguistics.

Principles

In the first place there are several outstanding principles which may be profitably considered.

1. In languages, as in evolution generally, we may apply the phrase *ex oriente lux*. All the chief languages may be traced back to the Asiatic cradle, which indubitably lay in the Persian and Turkestan areas.

2. The most primitive languages are now spoken in the outermost zone surrounding the center of dispersal. Thus Gaelic is the most primitive Aryan language. Latin is probably next; then come Greek, Teutonic, and Slavonic; and lastly Armenian and other Alpine languages. The earlier families are grouped in order of development outside the zone of the Aryan family (see Figs. 6 and 8).

3. Much confusion has resulted because many languages have been preserved by three major methods, which result in what may be termed *fossil*, *highland*, and *migrant* varieties. The last is the most important and the other two are often wanting. For instance Sanskrit is a fossil language buried under later strata of Prakrit, Pali, Pushtu, etc. Probably its migrant form is best represented in Lithuanian, but it is most important to realize that the Galcha mountaineers on the Hindu Kush (Siah Posh dialect) have preserved a very close approximation to the ancient Sanskrit (see Fig. 8).

4. The geological analogy of *inliers* (where islands of older strata project up through newer strata) and *outliers* (where islands of later strata are left isolated by the removal of their connecting deposits) may also be applied to comparative philology. Thus in the map of Europe (Fig. 6) the Basque

region is an inlier of Iberian speech which projects through the surrounding waves of Romance languages. The Pelasgian relics in Greece are inliers amid the much later languages which constitute Greek. In China the Lolo peoples occupy an inlier amid the encircling Mongolians. The Galcha are probably inliers among Mongolian peoples (see Fig. 8).

Outliers are more numerous, and the three Asiatic languages, Lapp, Finn, and Magyar, are good examples. Their congeners are to be found far away in Siberia, but we know that these tribes extended for a time right across Russia.

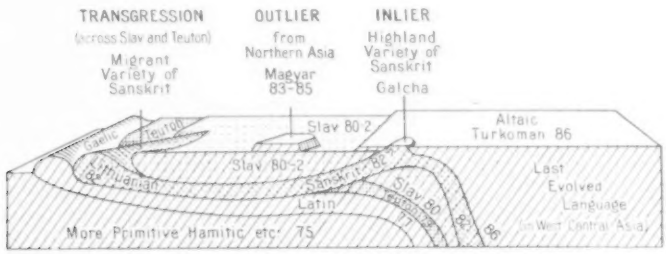

FIG. 8—Block diagram illustrating an analogy of geological structure applied to the migration of language. The order of evolution is that of the cephalic indices (75–86); but the migrations have been somewhat irregular, especially the Sanskrit Alpines (Lithuanians, etc.). Later the Slav tribes dominated the Sanskrit Alpines and were in turn overrun by the Altaic Magyars. Compare Figure 6.

The dominance of a language depends on a sort of mass effect. In Europe the Magyar and Finn have held their own, but no more, amid Aryan tongues. In China the converse occurs and the Lolo—of the Gaelic (?) horizon—have barely held their own among speeches allied to the Lapp and Magyar.

5. The most confusing condition arises when we have a transgression of speech somewhat resembling a transgression in stratigraphy. In this case a later language moves far across the earlier languages, not following in sequence but skipping many intermediate zones (see Fig. 8). An example occurs in Europe in the Alpine folk with a head index of 82–88. They arrived in Europe in Neolithic times, long before the Slavs (80–82) and probably before the Teutons (77–80). The important point to notice is that though they arrived first in Europe their speech was more advanced than that of the later comers.

6. It cannot be too strongly emphasized that the development of race and language of all the Aryans occurred in Asia during probably 100,000 years. Except perhaps in the case of the Gaelic tribes, more of their evolution has occurred in Turkestan or thereabouts than in their present abiding places to which many of them migrated only about 5,000 years ago.

7. The phenomenon of the shatter belt (see Fig. 1, Pl. I and Fig. 2) has been discussed earlier. Just as there are lines of weakness in the crust along which earth movements take place era after era, so there are corridors

THE LAVA-FLOW ANALOGY

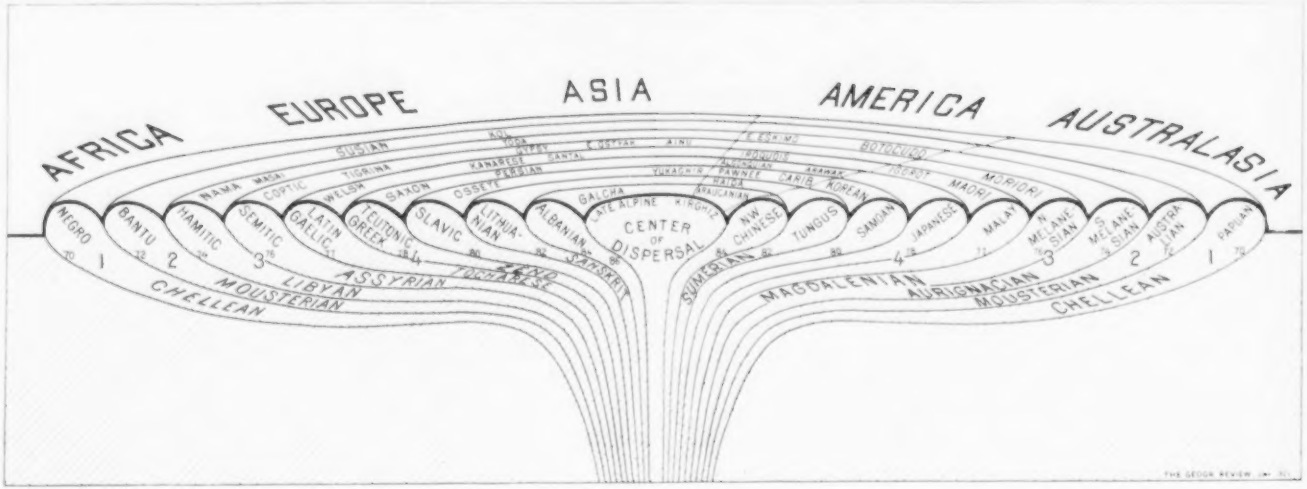

FIG. 9—The lava-flow analogy applied to studies of evolution and linguistics. The center of dispersal in Central Asia is pictured as a sort of "fissure eruption" sending forth streams of lava in all directions. Each new eruption arises from the center and, while covering some portion of the previous flow, pushes most of the previous lavas out to the periphery. Other analogies are represented in Figure 8. Fossil languages, buried under existing tongues, are seen in section. On the surface are shown existing languages typical of the several migration zones.

along which tribes migrate age after age. In both cases the margins are rent, pushed aside, and in part absorbed. This explains the conditions in the Caucasus and in California and Brazil, where the mosaic of dissimilar tribes flanking the great linguistic families are the débris fringing the main corridors of migration. I have no doubt that the shattered tribes in the Caucasus will ultimately be correlated with their Aryan (Pamir) or Turki (Altaic) congeners of the same cephalic index.

8. No language is at a standstill; but the isolated mountain or forest dialect—far removed from stimuli intellectual or otherwise—alters very little as compared with a civilized language. Nothing accelerates a language so rapidly as the development of writing. The three most advanced languages today are probably Chinese, Persian, and English. Of these English has developed most, for it differs in structure almost entirely from the synthetic inflected Anglo-Saxon and is now eminently analytic and uninflected. Persian has, I believe, undergone a similar change but has taken about twice the time. Chinese probably started with a higher (i.e. more concise and economical) language about 10,000 years ago and had advanced further than English about 5,000 years ago.

9. In all cases the study of evolution becomes much more simple if we ignore the developments of the last 500 years. Western Europe has had unique opportunities in her climate and in her resources. These, coupled with her choice of religion and philosophy, have given her the first place in the world, but it is too often assumed that race is the first factor and that religion is of equal importance, while environment is often ignored! The converse is nearer the truth; for, as we have seen, race *per se* has been only a small factor in the development of civilization.

The Lava-Flow Analogy

We may picture the center of dispersal in Central Asia as a sort of "fissure eruption" sending forth streams of lava in all directions. Each new eruption arises from the center and, while covering some portion of the previous flow, pushes most of the previous lavas out to the periphery. If we postulate that the early lavas still retain some mobility and occasionally flow across the later lavas, we get a very close analogy to what has happened in the migrations of man.

I have endeavored to show this in Figure 9. It explains fairly clearly the relations of the "fossil" to the "migrant" languages described above. On the extreme periphery we see the true Negro (70–72), who appears only in Africa and Papua. But we see that Cheilean relics *under* the center of dispersal still bear witness that he once lived in all the intervening zone. The next zone is the Mousterian, found all round the periphery in southern Africa, southern Asia, southwestern America, and Australia. Then come the Hamitic, Iberian, and Semitic peoples who have a world-wide distribution as the culture maps have shown.

Here the dead languages begin to help us. We have relics of Iberian writings in many Neolithic scripts, such as those figured by Sergi[54] from the French dolmens and from Cyprus, Crete, and Libya. The Egyptian hieroglyphs are Hamitic and allied to the modern Coptic. By analogy they may be found to be still more like some outlying Hamitic *migrants* that have preserved the more primitive speech. Assyrian and Babylonian are well known from the clay tablets. Their closest affinities in the same way may well be not with modern Syrian but with some tribes pushed away from Assyria by migrations about 5,000 years ago and now living on the periphery of the Semitic zone, e.g. in Abyssinia.

The Linguistic Problem of the Indo-Aryan Races

When we come to the Aryan languages the problem becomes very interesting, for we know more of the philology of the various speeches. My conclusions differ considerably from the orthodox views which I have come across in all textbooks.[55]

The palladium of the philologist is Sanskrit; but it seems evident to me that Sanskrit was first spoken thousands of years after Gaelic, Welsh, Latin, and possibly Teutonic and Greek had come into existence (in the order named).

The characteristic of the earliest Aryan tongues is the prevalence of the *k* sound (often as *qu* or *kv* or *kw*). This appears in Gaelic *kuig* (five) and Latin *quinque*. It is replaced by *p* or later by *f* in Welsh, Greek, and Teutonic (*pump*, *pente*, *funf*). Now in the Assyrian inscriptions we find reference to the Tochari, and these peoples (who lived in Bactria) are found to belong to the *k* tribes.[56] We can therefore show Tocharese as a dead *k* language in our diagram (Fig. 9) connected to the outer zone of Gaelic and Latin. Now Sanskrit uses the word *panch* (five) as do the present-day Galcha tribes (Swat and Siah-Posh) of the Hindu Kush region. It also uses the later form of the word for hundred, i.e. *satem* for *kentum*. Lithuanian is in many ways close to Sanskrit, and its word is *penki* which is merely a form of *panch*. If we use our "touchstone"—the cephalic index—we find that the Galcha lie on the isokeph of 83–85, the Lithuanians are about 83, and we may infer that the speakers of Sanskrit were of the same brachycephalic type. They were much later than the Gaels (76), Welsh (78), or Teutons (79).

The Indo-Aryan races may be subdivided first into the well-known *kentum* and *satem* groups and then as in Table VII:

If this table is accepted—and it seems to agree both with modern philology and with the migration-zone theory—then several important results follow.

[54] G. Sergi: The Mediterranean Race: A Study of the Origin of European Peoples, London, 1901, pp. 288–305.

[55] Except perhaps portions of T. G. Tucker's invaluable "Introduction to the Natural History of Language" (London, 1908), which I have used considerably in contrasting the structure of languages.

[56] See Encyclopaedia Britannica, 11th edit., Cambridge, 1910, Vol. 14, p. 495.

It shows that there was an enormous transgression in Neolithic times, whereby a very advanced language spoken by Alpine peoples was brought right across the center of Europe. They had a less powerful organization than the Etruscan and Mycenean civilizations so that the peoples of the latter (helped by some Alpine blood) dominated, and their primitive *kentum* languages prevailed. But, when the Roman Empire gradually absorbed the Dacians, the Wends, the Swabians, the Belgae, and the Alpine Kelts, it did not impose Latin upon these peoples (as every classical

TABLE VII—RELATION OF CEPHALIC INDEX AND LINGUISTIC STRUCTURE

GROUP		CEPHALIC INDEX	LANGUAGE	FIVE	HUNDRED
Kentum languages	*k* languages (v. five, etc.)	76?	(Tocharese)	?	?
		76	Gaelic	Kuig	Keud
		77	(Latin)	Quinq	Kentum
	p languages (v. five, etc.)	78?	(Oscan)	?	?
		78	Welsh	Pump	Kant
		78	Teuton	Fimf-Pimp	Hund
		79	Greek	Pente	(He) katon
Satem languages	Early Alpine	80	Persian	Panch	
		81	Slavonic	Pietz	Sito
	Later Alpine	82	Lithuanian	Penke	Szimta
		83?	(Sanskrit)	Panch	Satem
		84	Galcha	Panch	
		85	Armenian	Pese	

history seems to infer).[57] These barbarians had much higher languages of their own and very sensibly stuck to them. Their languages, for reasons stated, differed very little from Sanskrit, so that they readily adopted some of the Latin speech and syntax. It is most suggestive that the five languages which postfix the article are Lithuanian (82), Rumanian (82), Bulgarian (82), Albanian (83–85), and Old Norse. In the latter a small outlier of index 83 occurs (see map Fig. 6).[58]

In no other way can one account for the fact that the European Alpine peoples, though ethnologically homogeneous, have so readily taken to French or German or Italian or Rumanian or Slav. They all originally spoke something akin to Albanian or Ladin, a sort of improved Aryan tongue (like Sanskrit), to which Latin, Teuton, and Slav were slowly evolving. They met the lowland invader halfway, as it were.

[57] Tucker (*op. cit.*, p. 241) is much more frank and writes "We can only guess at the original language of stock B" [i.e. Neolithic Alpines (83–88)].

[58] Linguistic data from B. G. Latham: Elements of Comparative Philology, London, 1862, p. 625.

This may help to explain why all the cumbrous suffixes of Latin vanished so rapidly, while the roots (common to Latin and Alpine tongues) passed almost unchanged into the Romance languages. I am unable to find many data regarding the type Alpine languages in Europe (Ladin and Albanian), but Albanian is always classed as a *satem* speech (see Table VII).

The real connection between ethnology and language has, I trust, been brought out as regards the great Aryan group of languages. This is not the place to discuss phonetics, but I have no doubt that Grimm's law of phonetic change will be found to be related in no small degree to the climatic changes to which the tribes were subjected. These climatic changes were not only those inherent on their wanderings but were also secular and affected stationary peoples as well. In the 100,000 years occupied in the variation of the Aryan languages there were, in my opinion, four considerable secular changes of climate; and the tribes themselves marched from arid Central Asia to cold wet Norway, so that the climatic stimulus varied greatly and was undoubtedly very important. I hope to develop this in a later paper.

Space does not permit of adequate treatment of the other great linguistic families, the Negro, Bantu, Dravidian, Hamitic, Melanesian, Iberian, Semitic, Malayo-Polynesian, Ugrian, Tungus, and Chinese, not to mention the horribly complicated tangle in North and South America. But it seems logical to me that the principles I have applied to the Aryan group cannot fail to help comparative philology in other continents. I propose to summarize the evidence which I have collected in the hope that later the problems may be undertaken in detail.

Table VIII shows in a highly generalized fashion some of the main concepts in this paper. The cephalic index is correlated with the languages and customs of type races in the four continents. The customs have been correlated previously, but the languages, especially of America, are merely inserted to help further study. I feel sure that some such seriation is legitimate, but the evidence to date is admittedly slender.

The Most Primitive Languages

We may rapidly run through the series of languages in the region between South Africa and China. The most primitive languages are probably those of the Sudanese Negroes, allied to Wolof, etc. This group extends across Africa to Abyssinia, where there is a typical shatter belt of all sorts of languages. The languages are not capable of expressing delicate shades of meaning, and there are no genders, etc. Curiously enough their very primitiveness makes them in some ways resemble Chinese, English, and other highly evolved languages. In former German East Africa the Mbugu are a Sudanese group, where primitive inflection is just beginning to approximate the language to Bantu.[59]

[59] Alice Werner, transl.: An Introduction to the Study of African Languages, by Carl Meinhof, London, 1915

TABLE VIII—EVOLUTION OF CULTURE AND LANGUAGE (TENTATIVE CORRELATION)

GROUP	MIGRATION ZONE AND CEPHALIC INDEX	LANGUAGE TYPE	TYPICAL CUSTOMS, FOLKLORE, ETC.	AFRICA, EUROPE	ASIA	AMERICA (SUGGESTED ONLY)	AUSTRALASIA
I	Negro (70–72)	Jejune; often reduplicating; absence of gender; few numerals	Fetishism	Sudan and Guinea tribes Mbugu			Papuan
II	Mousterian (72–74)	Very complex prefixes and suffixes; much alliteration	Fetishism matriarchy; group marriage; boomerang; totemism	Bantu	Nair, etc.	Botocudo?	Australian New Hebridesan
III	Hamitic (74–75)	Polysynthesis common; and more regular synthesis	Couvade; totemism; serpent cult	Masai Fulah Basque	Dravidian	Eskimo Iroquois	Dentrecasteaux
	Semitic (75–76)	Triliterals	Couvade; serpent cult	Coptic Tigrina	Arabic Hebrew (Kanarese)	(Algonquian)	South Solomon
IV	Early Aryan (76–78)	Highly synthetic (*kentum* in west of Eurasia)	Monoliths; Gaelic belt; tattooing; levirate	Gaelic, Latin, Greek, Teuton (*k*) (*p*)	Igorot Japanese Korean	Algonquian Arawak Athapascan	Malay S. E. Papuan Maori
	Late Aryan (78–80)	Highly synthetic to analytic (*satem* in west of Eurasia)	Unforked kin words; levirate; shamans; swan-maiden myths	Slavonic	Persian Galcha	Carib Tlingit Haida	Louisiade E. Solomons
	Early Alpine (80–85)	Vowel harmony; clear suffixes to root; losing inflections	Forked kin words; head deformation; shamans	Magyar Serb Czech	Finn Tungus	Shoshone Aztec? Sioux?	Hawaiian Samoan Tahitian
	Late Alpine and Mongolian (85–88)			Albanian	Kirghiz	Quichua?	
		Tending to positional; monosyllabic	Early triumph of art and social law		Chinese		

The Groups I–IV are related to the Four Great Ice Ages.

THE "MOUSTERIAN" LANGUAGES

The next great family may be called the Mousterian. It includes the Bantu, a few low tribes in India (Nair?), and the Australian. By this time inflection is in full swing. In Bantu (74) prefixing usually prevails, and we shall note a gradual change as we ascend the scale. Thus in Semitic (76) we find prefixing and postfixing about equally developed. In Aryan

(79) inflections are mostly postfixed. In Ural Altaic (83) the affixes are always postfixed.[60] Australian is higher in type, for may tribes have three numbers (including dual). The inflections are usually suffixed and are extremely numerous and complicated. Thus the noun expresses time also. Genders are not usually shown by inflection.[61] I have no data of the cognate Indian tribes.

Hamitic and Iberian Languages

The next zone includes the Hamitic tribes, who are well represented in the Sudan, in the Deccan, and probably along the eastern coast of America. They have developed along somewhat different lines in these three widely separated regions. In Africa the most primitive type is the Hottentot Nama, who is an "outlier" of relatively high head index (75) amid lower Bantu. It preserves the primitive dual number, like the Bantu, but has the general character of the Hamitic tribes. These have full inflections for number and gender. The feminine (or weaker) gender is marked by *t*, which also characterizes many Semitic languages. There is no doubt now that Semitic has been derived from Hamitic.

Basque is spoken by a very mixed set of peoples in the Pyrenees. The majority have a head index about 79, but a few Cevenole (84) villages are also included. The language seems to be more nearly allied to Berber (Hamitic, 76) than to any other, and the nucleus of the Basque country has folk of this head index. Is it possible that we have an isolated Etruscan colony here, like the corresponding one in Nigeria, which once dominated a much larger region? The Basque language is therefore a fine example of a retrogression in that the speech of a lower race has conquered that of a higher. We get the same thing in the interior of Victoria, where you may hear a veritable pure-blood Chinaman asking for his "pyper" (i.e. newspaper) in typical Australian vernacular! Basque is of course the sole European language (with possible exception in the Caucasus) which incorporates the object in the verb. This is very characteristic of the American languages. Basque takes in the direct pronominal object (and French has a touch of this also). Iroquois can also incorporate the noun object in the verb and "has nothing in common with the structure of the Algonquian or Sioux languages"[62] adjoining. This can only mean that it belongs to a different migration zone, as I postulated from the head form (76 or so) in my previous paper. No error has been so widely promulgated as that all American languages are polysynthetic and incorporating. The best-known tribes were the eastern *primitive* tribes, just as in Eurasia the best-known were the western *primitive* tribes. One incorrect, if natural, result of this has been to place the Teutonic speech on a pinnacle which it by no

[60] Henry Sweet: The History of Language, London and New York, 1900. The figures are cephalic indices, which I have added.

[61] Roth: West Queensland Aborigines, 1897. (Pitta Pitta tribe.)

[62] Franz Boas: Anthropology of Canada, 1910, p. 530.

means deserves and to degrade the Amerind languages to the level of the (Hamitic) Iroquois, which is almost the lowest in the continent! Such are some of the results of the neglect of a geographical treatment of linguistics.

Semitic Languages and Their Relation With Aryan

The next great group which we meet in our traverse is the Semitic. This is best known from Hebrew and Arabic. It is somewhat sharply

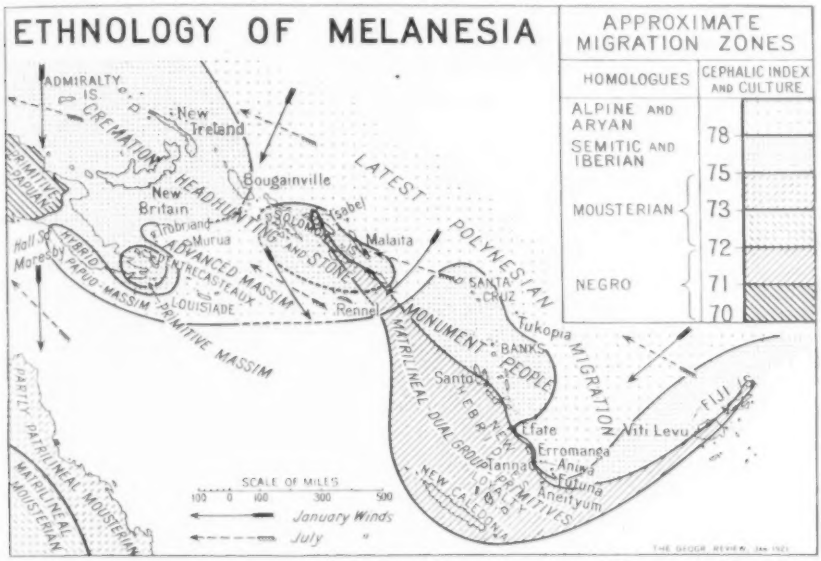

Fig. 10—Map showing the ethnology of Melanesia (based in part on Rivers, Seligman, and Codrington). The migration zones merge somewhat, especially in the north. The Polynesian migration from the east has cut across the earlier Iberian and Negro migrations.

marked off by the triliteral words which build up much of the language. Thus *falat* (bend) is changed into *filat*, *fulatu*, *falu*, etc., much as we add inflections. Macdonald has shown that this scheme is quite usual in languages of Melanesia,[63] in fact just where the Black Jews mentioned previously are found. He shows also many similar roots connecting Efatese (Melanesian) with Arabic and Malay and of course also with Polynesian.

I have no doubt whatever that the clue to the connection between Hamitic, Semitic, Aryan, and Alpine languages will be found in the numberless dialects extending from Aneiteum (New Hebrides) to New Britain and to Samoa. Here each group of islands is occupied by a wave in the migration zone, and we can trace the evolution of head form from 74 to 83 and the corresponding change in language more clearly than anywhere else in the world.

[63] D. Macdonald: The Oceanic Languages, London, 1907.

Macdonald believes that the Melanesians came straight from Arabia, but they are of course primitive tribes pushed out of Burma and Malaysia by the great Aryan and Mongolian migrations. The Tagala language in the Philippines has Semitic affinities, e.g. it modifies a word even more peculiarly than does the Semitic ablaut. Thus the triliteral *sulat* becomes *s (in) ulat (an)*.

Judging by analogy some of the Algonquian tribes should show Semitic features. No doubt the old stories of the Lost Ten Tribes and of Hebrew words in America will have some slight foundation in this respect. If the Haida-Tlingit (80) group has affinities with Melanesian, as Boas suggests, it is most probably with the northern Melanesians, who have a head index about 79 (e.g. in New Britain), and not with the Black Jews of the Solomons.

The connection between Semitic and Aryan in the Eurasian region is very vague, probably because the Assyrian and allied dialects were highly altered from their primitive condition. No doubt primitive Semitic dialects (perhaps from Abyssinia) will show a relation to primitive Aryan, e.g. Gaelic or some Deccan dialects.

Aryan Languages Outside Europe

The Aryan group has been treated fairly fully for the European section. The connection with the lower Indian dialects (e.g. Kanarese, 76) is quite readily distinguished. I have no doubt that the Lolo peoples (who wear garments like those of the Bretons and other primitive Aryans) speak an Aryan language.[64] There are many features in Maori (79)[65] which remind one of modern English, for instance the articles, the uninflected noun, the feeble development of gender, the prepositions, and their relation to article and noun. Other features however are unlike. Japanese to some extent seems of a primitive Aryan type. It has independent pronouns but with clumsy forms still showing their origin (e.g. "I" is translated by an abbreviation of "selfishness"). It has noun suffixes, which are however to some extent separable and show their etymology also. It is of course not even remotely connected with Chinese (though it derives hundreds of words from the latter) but has many affinities with Malay and Polynesian.[66]

In North America many of the Plains Indians speak languages remotely resembling Aryan, e.g. Pawnee (85) bears resemblances to Sanskrit (83). Athapascan (83–78) does not incorporate readily, and the object is independent. It is most interesting to note how the small units on the western coast (in the shatter belt) agree with the less disturbed tribes on the other side of the Great Corridor. Thus we may compare the sections using

[64] Described as monosyllabic. See A. F. Legendre: Far West Chinois. *T'Oung Pao*, Series 2, Vol. 10, 1909, pp. 349–380, 399–444, 603–665; reference on p. 635.—Edit. Note.

[65] The lower Polynesians resemble the Greeks and Persians in their substitution of H and S. Grimm's Law connecting P and B, T and D also holds for Polynesians as for Germans (Tucker, *op. cit.*, p. 237).

[66] "Polynesian could never be classed as agglutinative, inasmuch as it expresses grammatical relations by free particles after the manner of the most advanced analytical tongues such as English" (Tucker, *op. cit.*, p. 141).

Athapascan speech—two small groups on the western coast and two much larger groups on the eastern side of the (later) Shoshone and Navajo nations. Salishan Chinook are probably not far removed in kin from some Athapascan tribes; but there has been a great transgression of the Athapascan dialect, as I have suggested earlier, and details are too few for me to do more than suggest their ethnic and linguistic affinities (see Fig. 2).

As regards the Alpine and Mongolian peoples we may consider for a moment their distribution in Asia. The Alpine folk of the southwest, Galchas, Armenians, etc., were undoubtedly once in contact with the great Alpine group of central Europe. They spoke an Aryan tongue. But the tribes to the northeast of these, e.g. the Kirghiz, Yakuts, etc., though of somewhat the same head form, were presumably isolated from the Galchas, etc., by the marshes and deserts of the country about the Aral sea. Hence their languages are not particularly similar, though as usual the most primitive representative, Finnish (81–83), is readily compared with Slavonic (81–83).

The Finns, Magyars, Turks, and Tatars entered Europe from the northeast, the other European Alpine peoples came from the southeast; hence the distinction (see Fig. I, Pl. I). The isolated position of the Yenisei Ostyaks has often been remarked. Their language is akin to none near by, nor is their head shape (76). Probably Ainu is a congener.

The great group of Paleo-Siberian folk in the northeast of Siberia (Chukchi, Koryak, Yukaghir, 82) have been found to agree linguistically very closely with the similar zone in Alaska and Canada. I do not see why it is necessary to assume that the Yukaghir originated in America, as some ethnologists aver. This would be contrary to all the other evidence of migrations. For the same reason we must assume that the Eskimos are of Asiatic and not European origin. The pure tribes are, as always, found furthest from Asia, i.e. in Greenland. Here they are shorter and less Mongolian, in fact true Aurignacians. The Western Eskimos are obviously a mixed people.

It does not seem to be realized by Americans how diverse are the various Melanesian peoples. (The writer no doubt makes similar false analogies with regard to Amerinds.) For instance the Salishan speech is described as more like Oceanic than Algonquian. I can quite believe it, but "Oceanic" ranges from "Hamitic" up to "Alpine." Furthermore, some of the old analogies, which are almost forgotten today, seem well worthy of revision. Thus Petitot compares Algonquian with Celtic, Mendoza relates Nahuatl to Aryan, and Hamy says Otomi is isolating and monosyllabic like Chinese.[67] In many respects these seem to the writer very logical comparisons, though he cannot refer to the original papers.

[67] Quoted by A. F. Chamberlain: The Problems of the Unity or Plurality and the Probable Place of Origin of the American Aborigines: The Problem from the Standpoint of Linguistics, *Amer. Anthropologist*, Vol. 14, (N. S.), 1912, pp. 50–57. [It should be stated that Chamberlain regards all such comparisons as "unjustifiable."]

As regards South America, I cannot get any data of value. There is little doubt of a general evolution from the Ges speech of the Botocudo (74) up to the concise highly-developed speech of the Araucanian (86).[68] The same phenomena of corridors, shatter belts, outliers, inliers, and transgressions are obvious, but it is not possible for an Australian to cope with them. One main reason is because the Americans seem to have abandoned the cephalic index as one of the mainstays of ethnology; and even Wissler's most valuable textbook gives very few coefficients beyond those I have used so continuously from Deniker. I trust that this paper, if it does nothing else, will show how helpful is this old-fashioned criterion and will lead to renewed activity in measuring the aboriginals who are everywhere vanishing before the so-called "white civilization."

One last word as to the highest type of speech. Ethnic data are wanting for Central Asia. The Chinese of the coasts are put down at about 85, but the purest and last developed Chinese will be found in the northwest. Here it is quite probable that they rise to 88. Thus we have two groups of peoples, the Alpines and the Neo-Chinese, included within the 86 isocephalic line. They have never mingled to any degree, for the topographic conditions have been adverse. Bleak steppes to the north, a huge arid plateau in the center, and the Himalayas to the south have kept them independent for 50,000 years, except perhaps for some contact in Persia and the Tarim region. The Alpine folk have never produced a purely Alpine civilization, though the whole of European progress since the Achean invasion of B. C. 1000 has been leavened by their sterling virtues. But, owing to a variety of factors, Etruscan civilization (76) has been followed by Roman (76–77), and this by Spanish (77) and British (78). The Carlovingian and Hapsburg dominations were, I suppose, Alpine. Possibly the whole matter turns on command of the sea, for the European Alpines have never been coastal peoples except in Dalmatia. Today the most highly evolved crania of the West belong to the Swiss and the Albanians. Who shall say how far they might go, should militarism be scotched and the small nations be able to give themselves freely to the arts?

Chinese Compared With Modern English

Of the Chinese I have written much already. Their language was undoubtedly a thousand years ahead of any other at the dawn of history. Why has it not progressed? I am inclined to think that this is due chiefly to two factors. Their philosophy was eminently conservative, so that everything must be sanctioned by custom. This method of everlastingly "looking backward" for precept and guidance kills all progress. Moreover they were remarkably free from competition with any other nation. No doubt they were often at war but always with barbarians. They lived in a sort of

[68] The same structure of the verb is found in Araucanian and Turkish (Tucker, *op. cit.*, p. 87). It is significant that these races are on the same isokeph (84–86), and probably both originated in southern Siberia about the same time.

"Yellow China," and all history shows that nothing can be so harmful to a nation, if this policy be carried too far.

Modern Chinese, like modern English, consists largely of "small square strong root words" far superior to the inconvenient flexion-encumbered Indo-Germanic sentence word.[69] It has an abundance of auxiliary words just as we have in English. It makes great use of *position* as a clue to the meaning of a sentence and in fact uses much the same word order as we do. There are practically no inflections.

If we study outlying allied languages such as Tibetan we can trace the development of Chinese from something akin to Manchu to its present form. It is false to say that Chinese is one of the most primitive and jejune of languages. Possibly it is not very flexible, but I am inclined to believe that the spoken language is superior to the written in this respect. If the Chinese people could only drop the archaic pictographs, or ideographs, of which 3,000 must be remembered (in place of our 26 letters) I can imagine that Chinese would take rank with English as a world language. It is indeed gratifying that the English speech has developed within a short 1,500 years from the archaic Anglo-Saxon to one of the best means of expression. Let us pray for the time when the orthography shall be worthy of such a noble language so that the spelling may be fitted to the spoken word and not preserved merely to simplify the labors of etymologists!

Conclusion

If my views are correct, it is obvious that many current opinions with regard to the mixing of nations are not supported by ethnology. It is most unfortunate that the half-caste problem has aroused most attention in the United States and in India, and that all our ideas are inevitably colored by results in those regions. The African Negro is the least evolved of the races of man, and ethnically the white negro half-caste is lower than the white. Possibly there may be something in the idea that the cranial sutures close too soon in the case of the Negro to admit of full expansion of the brain. In most of India the tribes are of a lower ethnic type than the European. Even in the north the so-called Aryan tribes are largely pre-Aryan (below 76), though with the Aryan speech. Hence here also the Eurasian may very well be below the white standard, unless the most advanced Indians are involved. I am disposed to think, however, that in many cases the ethnic deterioration is too slight to be important and that racial antipathy rather than racial degeneration is largely to blame for the troubles of the Eurasians.

As regards the Alpine, Mongolian, and most Amerind and Polynesian peoples the future seems to me to be most promising. It is our diseases and our vices, especially the use of alcohol, which constitute the so-called "overpowering effect of the white civilization" upon the uncivilized nations.

[69] J. O. H. Jespersen: Progress in Language, New York, 1894, p. 127. See also Tucker, *op. cit.*, p. 125.

When they are protected from these evils, and when public opinion is educated to regard them as our ethnic equals instead of as our inferiors, we may hope to see them thriving equally with the European nations. In South America, as Bryce has pointed out, the *mestizo* is quite equal to the pure Spanish peasant. He may well be so, for the Spanish Iberian is in many cases raised in the ethnic scale by the mixture with Aryan or Alpine blood which fills the veins of so many Amerinds. The same results may be expected with regard to most Mongolians, with the possible exception of the southeastern tribes of Asia, where, it may be, there is a large proportion of lower Aurignacian stock.

Appendix

The Climatic Cycles

In my former paper I expressed my belief that the Ice Ages occurred at intervals of about 200,000 years, and I suggested as possible causes planetary or stellar disturbance. Only recently have I learnt that G. H. Darwin had suggested a cycle of 200,000 years on the variations of the orbit of the earth.[70] Croll's similar work did not appeal to me, for his cycles recurred every 21,000 years, which is certainly not the case with the Ice Ages. It is, however, quite possible that his short cycles accounted for minor migrations.

If now the shape of the earth's orbit changes from nearly circular to relatively elliptical, we shall get the change from *uniform* climates to *zonal* climates which I described fully before. This change in orbit is, I understand, supposed to be largely due to Venus and other planets in our solar system; and Darwin's suggestion certainly encourages me to believe that some such agency is operative in determining my minor cycles. Why, however, do not the Ice Ages recur *every* 200,000 years? Why does the earth enjoy a uniform climate for nearly 100,000,000 years before the next set of Ice Ages as postulated in my *major* cycles?

It seems probable that at each *major cycle* the earth is subjected to two different forces. (1) The orbit becomes very elliptical with the results given above. (2) The earth's crust is subjected to great strains so that buckling and cracking occur and the mountain systems are redeveloped from old peneplains. We know that precession is due to a differential pull by the moon and sun on the equatorial bulge. Is it not possible that some unknown stellar body can affect our solar system each 100,000,000 years so as to cause much greater strains on the crust at the earth's equatorial bulge? I am aware that it seems difficult to imagine the earth being so affected without considerable derangement of the planetary orbits. Since, however, the earth can change its orbit, as astronomers admit, this may not be an insuperable objection.

[70] Cited in H. G. Wells: The Outline of History, 2 vols., London and New York, 1920; reference in Vol. 1, p. 20. I have not been able to verify the original statement.

Finally, I should like to draw attention to the interesting diagrams in Huntington's "World Power and Evolution." Here (in Chapter VII) a cycle of climatic changes (cold wet, dry arid, warm moist) has been graphed. This is the same as I had deduced by another method, quite independently, though at a later date.

Summary

1. Attention is drawn to the value of the cephalic index as corroborated by the research of Macalister and Venn. Both the infantile and primitive skulls are relatively long (dolichocephalic), and in both there is a gradual change (racial and individual) towards brachycephaly.

2. The relation of color to head form and temperature is investigated. The sequence yellow, olive-brown, dark brown, chocolate occurs fairly regularly in zones around Tibet.

3. The present is an age of great geological evolution. Evidence based on the chief earthquake zones and on the distribution of terrigenous deposits in the Pacific shows that the coastal plains around the latter have sunk during the Pleistocene and so destroyed many of the chief migration corridors.

4. Data as to the Negrito seem to show that nowhere is the pure type preserved. The more primitive Negritos are progressively more dolichocephalic.

5. Seven charts are given showing the migrations of the various races from Asia during the Four Ice Ages and Interglacials. Thus in the Mindel Age, Negrito, Negro and Mousterian are migrating. In the Riss-Würm Interglacial the Iberians are developing in Asia, and in the Würm age the Aryans. The Azilian is marked by tremendous hordes of Iberians and Aryans entering America. The corridors of Gibraltar and Bering broke through about this time. The last chart shows conditions much as they were before the great modern migrations of European races to other continents.

6. Certain regions containing débris of many diverse tribes are called "shatter belts." They occur along the outside of the main corridor from Asia to America, in the Caucasus, in Abyssinia, and in Brazil. Their relations to the less disturbed tribes on the opposite side of the corridor are discussed.

7. The evolution of culture is dealt with in each zone. The curious parallelism of race distribution in Africa and in Australasia indicates that the peoples must have originated to the north of, and midway between, the two continents (i.e. in Central Asia).

8. The Mousterian culture, including totemism, the bull-roarer and the boomerang, is characteristic of the most primitive zone with head index 72–74. Similarly the Hamitic zone (74–76) is sharply defined as the couvade horizon in ethnology. The serpent and sun cults are of this zone also.

9. Reasons are given for allying the Semitic peoples with the earlier Hamitic races rather than with the succeeding Aryan races. Linguistic studies support this theory.

10. The Nordic races at the base of the Aryan (76–77) are marked by the monolithic monuments, and by the custom of tattooing. The Gaelic belt is well defined from Scotland to the New Hebrides. The folklore (such as the deluge and swan-maiden stories) forms a well-marked horizon.

11. The racial components of the European nations are tabulated. The French, Italian, and Grecian nations are shown to be as diversely constituted as the lately dismembered Austrian Empire.

12. Some success is obtained in disentangling the invasions of Europe by brachycephalic Alpines in Neolithic times. These preceded many dolichocephalic Teutons and all the Slavs, though these latter had originated first in the Turkestan region.

13. Levirate, head deformation, marriage by capture or purchase are discussed as regards "zoning" of the later Alpine and Mongolian races. The high status of the Chinese at the dawn of history is described, but it seems possible that the southern Chinese have incorporated many early Aurignacian tribes.

14. The rise of the various great civilizations is discussed in terms of environment and head form. The former is shown to be the controlling factor, and race has little to do with it provided the cephalic index be above 76. In almost all cases there has been a marked climatic deterioration in the regions famed for ancient civilizations. On the whole, races of medium head form have become dominant. The belts of civilization, like the isotherms, have moved poleward during the historic period.

15. If the languages comprised in a family be examined it will be found that the most primitive is spoken by tribes with the lowest head form, whose habitat in general is farthest from Central Asia. Thus Gaelic (76) and Latin (77) are more primitive than Welsh (77) or Teutonic (78) or Greek (78). All these are less evolved than Slav (81), Lithuanian (82), or Sanskrit. (Cephalic indices slightly smoothed.)

16. Many languages are preserved in three forms: fossil (like Sanskrit), highland "inliers" (like Galcha) or migrant (like Lithuanian). These concepts are described in terms used in geology, e.g. outliers, inliers, transgressions, shatter belts, etc., with considerable advantage.

17. The evolution of the various languages is graphically depicted like a series of lava flows emanating successively from a common center (Turkestan, etc.). Thus Bantu precedes and is thrust away by Hamitic, which is displaced in turn by Semitic (and then follow Aryan, Alpine, etc.).

18. The classification of the Indo-Aryan languages into *kentum* and *satem* and *k* and *p* forms is correlated with head forms and with the migrations. It seems evident that Sanskrit was developed long after the Latin and Greek tribes had left Asia.

19. The Neolithic Alpines spoke a more advanced language than the

Romans or Greeks. It was akin to Sanskrit, and the Romance languages are not developed from Latin but are merely Alpine tongues slightly modified by the Roman speech.

20. The Semitic tongues are akin in structure and vocabulary to the Melanesian languages. It seems probable that the linguistic links joining Hamitic to Semitic (and so to Aryan and to Alpine) can be more profitably studied in Melanesia than in the Mediterranean region, where the races are more intermingled.

21. Little comparative philology has been done on the Amerind languages, but it seems clear that they progress regularly from Iroquois through Algonquian and Athapascan to Shoshonean and Siouan. In the southern continent there is a parallel progression from Ges through Tupian, Cainguan, Arawakan, and Cariban up to Araucanian. This is, however, merely a suggestion based on the sequence found in other continents.

22. The writer can see no good reason for believing that the Paleo-Siberians (Chukchi, Yukaghir, etc.) evolved in America. The similarity of their languages with Amerind speech is in keeping with the analogous agreements found all over the world. But the migrations were the other way, from Asia to America. The same argument applies to the Eskimos who also moved from west to east.

23. The latest developments in speech and race occurred among the Alpines and late Mongolians. These are parallel variants of the same zone (83–88) who have remained fairly distinct because there has been a great physiographic barrier between them during the last 20,000 years or so.

24. The Chinese language, so far from being primitive, in many ways shows the type to which English (with its strong abbreviative and amalgamating tendency) is unconsciously evolving. Research on kindred dialects shows that Chinese had passed through the synthetic stage before the dawn of history. The development of early Turanian from late Aryan can be made out in northern India. Here again the Chinese come out near the apex of human evolution. Their only ethnic rivals are the Alpine folk extending from Savoy through Rhetia, Albania, etc., to Armenia and the Pamirs. These latter have not had so favorable an environment and so had not developed a high civilization before 3000 B. C. like the Chinese.

25. In an appendix some notes are added on the duration of the climatic cycles which cause the Ice Ages and which ultimately determined the major features of human evolution.

THE SECULAR VARIATION OF CLIMATE

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Meteorological Office, Great Britain

The influence of variations of the sun's radiation on terrestrial climate has been the subject of many mathematical investigations. In former years these have dealt almost exclusively with the "sun-spot period" of approximately eleven years; more recently variations of shorter period, from a few days up to five years, have come into favor. But with all these periods the problem is complicated by the fact that the variations of terrestrial climate directly dependent upon variations in the supply of solar heat, themselves cause further terrestrial changes, and so on in an endless chain. Even the eleven-year "sun-spot period" is apparently not long enough for these repercussions to die down sufficiently to allow us a clear vision of the relation between the solar cause and the terrestrial effect. The shortest oscillations of a few days period have the advantage of instant and obvious action on temperature, but they have little effect on other elements and apply only in certain favored regions.

Table I—Sun-Spot Numbers, 1749–1918

Year	0	1	2	3	4	5	6	7	8	9
1740	..	..	..	..	..	..	..	..	..	81
1750	83	48	48	31	12	10	10	32	48	54
1760	63	86	61	45	36	21	11	38	70	106
1770	101	82	66	35	31	7	20	92	154	126
1780	85	68	38	23	10	24	83	132	131	118
1790	90	67	60	47	41	21	16	6	4	7
1800	14	34	45	43	48	42	28	10	8	2
1810	0	1	5	12	14	35	46	41	30	24
1820	16	7	4	2	8	17	39	50	62	67
1830	71	48	28	8	13	57	122	138	103	86
1840	63	37	24	11	15	40	62	98	124	96
1850	66	65	54	39	21	7	4	23	55	94
1860	96	77	59	44	47	30	16	7	37	74
1870	139	111	102	66	45	17	11	12	3	6
1880	32	54	60	64	64	52	25	13	7	6
1890	7	36	73	85	78	64	42	26	27	12
1900	10	3	5	24	42	64	54	62	49	44
1910	19	6	4	1	10	46	55	99	78	..

In these circumstances it seemed desirable to go to the other extreme and study the connected variations in what may be called their "secular" trend. Table I shows Wolfer's sun-spot "relative numbers" from 1750 to date, and Figure 1 shows the same numbers graphically, smoothed over an eleven-year period, each eleven-year mean being entered to the middle year. This brings out a longer variation of no particular period. The last chief maximum occurred about 1835; but the curve rose to almost the same point in 1870, and the subsequent decline is still in progress.

It is on this last phase that attention is concentrated in this study. By 1870, or shortly after, a large number of meteorological stations had been established in all parts of the world, and many long series of homogeneous

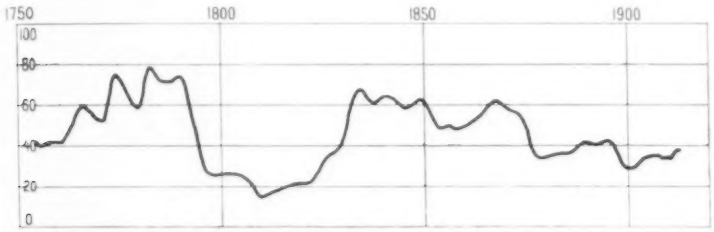

FIG. 1—Sun-spot numbers (eleven-year means).

observations are now available for study. Most of those employed here were collected by G. T. Walker of the Indian Meteorological Office for an investigation of the relations of climate and sun spots and were generously made available for other investigators;[1] a few other figures have been collected for unrepresented or specially interesting areas. These figures have been analyzed for secular variation by the method of correlating with time.

The process is as follows: The series of, say, mean annual pressures are represented by deviations, $p1$, $p2$, $p3$, . . . pn, from their common average and arranged in a column with their earliest year at the top. Against the middle year of the series is written 0, and from this line the figures $-1, -2, \ldots -n/2$ are written upwards and the figures $1, 2, \ldots n/2$ downwards so that the earliest year has the value $-n/2$ and the latest year $n/2$. The following sums are then calculated:

the squares of $p1, p2, \ldots pn = \Sigma p^2$
the squares of $-n/2, -n/2 + 1, \ldots +n/2 = \Sigma y^2 = n(n+1)(2n+1)/3$
the products $p1(-n/2), p2(-n/2+1), \ldots pn(n/2) = \Sigma p.y$

The correlation coefficient r is given by the formula:

$$r = \frac{\Sigma p.y}{\sqrt{\Sigma p^2 \Sigma y^2}}$$

[1] G. T. Walker: Correlation in Seasonal Variations of Weather, *Memoirs Indian Meteorol. Dept.*, Vol. 21, Parts IX–XII, (= pp. 12–118), Simla, 1914, 1915.

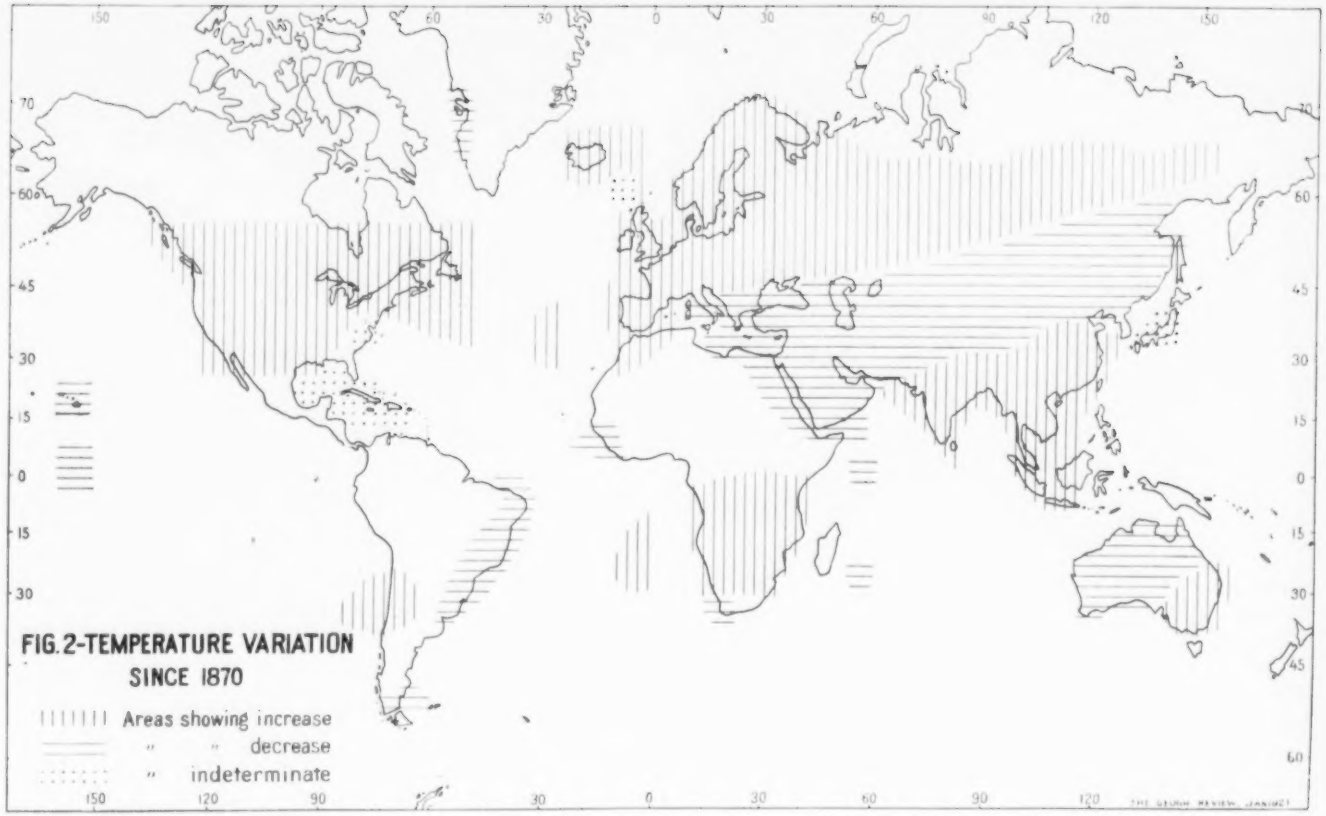
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FIG. 2-TEMPERATURE VARIATION
SINCE 1870
Areas showing increase
" " decrease
" indeterminate

This gives the closeness of the connection between the variations of pressure at the station in question and the advance of time. A perfectly regular increase of pressure gives a correlation coefficient of $+1$, complete independence gives 0, and a perfectly regular decrease gives -1.

A figure of greater practical value is represented by b, which is the coefficient of the regression equation:

$$p = b.y$$

b thus gives the average amount by which pressure increases or decreases each year. Finally e is the probable error of the correlation coefficient, which means that the chances are even whether the real value of r, as distinct from the calculated value, lies between or outside the limits $r + e$ and $r - e$. For a value of r to have an undoubted significance it should be at least three times the value of e, unless other considerations come in.

Since the figure which is being employed ultimately—the average change per year—could have been calculated much more rapidly by a simple application of the method of least squares,[2] it may be asked why go to the labor of computing correlation coefficients? The answer is that the latter show how much of the observed standard deviation can be attributed to the secular variation and how much is due to other causes. The results of this part of the investigation will be referred to later, in connection with Table II, which gives the values of r, b, and e for a large number of stations, classified geographically, for pressure and temperature. Similar values for rainfall were communicated to the Royal Meteorological Society recently in a paper entitled "The secular variation of rainfall."[3]

Distribution of Climatic Changes

So much for the mathematical part of the investigation. In Figures 2, 3, and 4 are shown the results of plotting the values of b. Areas where the element in question has been increasing since 1870 are shown by vertical shading, areas of decrease by horizontal shading; indeterminate areas are stippled, and unrepresented regions are left blank. The results are sufficiently striking. Considering first temperature (Fig. 2), we have the ollowing definite areas of increase:

1. Temperate North America, most of Europe, and northern Siberia.
2. Southeastern Asia.
3. Northern Chile, South Africa except the tip, and southeastern Australia.

Areas of decrease are:

4. Western Greenland.
5. A belt including eastern South America, most of northern Africa, Arabia, and Central Asia to Saghalien.
6. Most of Australia and the tropical Pacific.

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[2] E.g. by the formula: $b = \dfrac{3\Sigma\, p.y}{n\,(n+1)\,(2n+1)}$

p being deviation from normal and y difference of date from middle year.

[3] *Quart. Journ. Royal Meteorol. Soc.*, No. 191, Vol. 45, 1919, pp. 233–248.

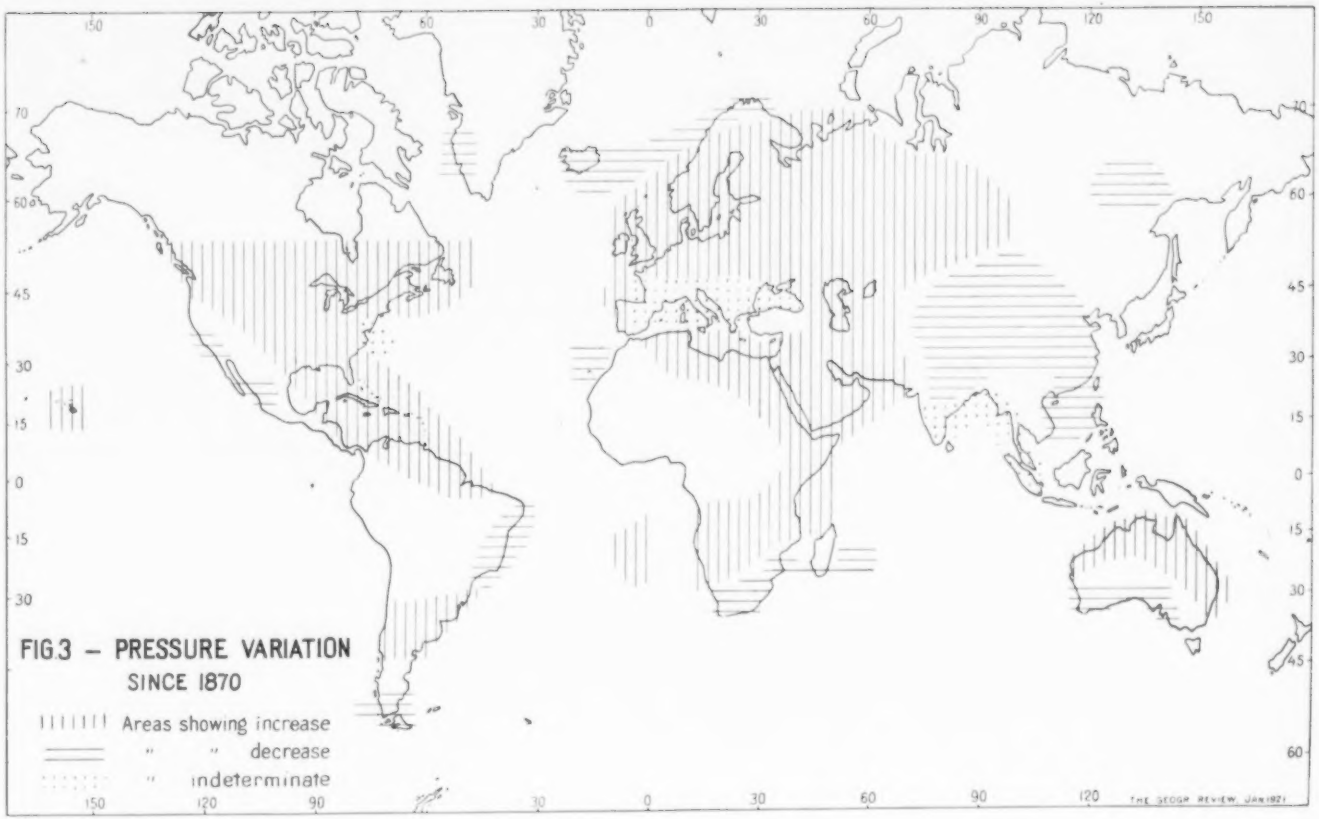
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FIG.3 – PRESSURE VARIATION
SINCE 1870
Areas showing increase
" " decrease
" indeterminate
THE GEOGR. REVIEW, JAN. 1921

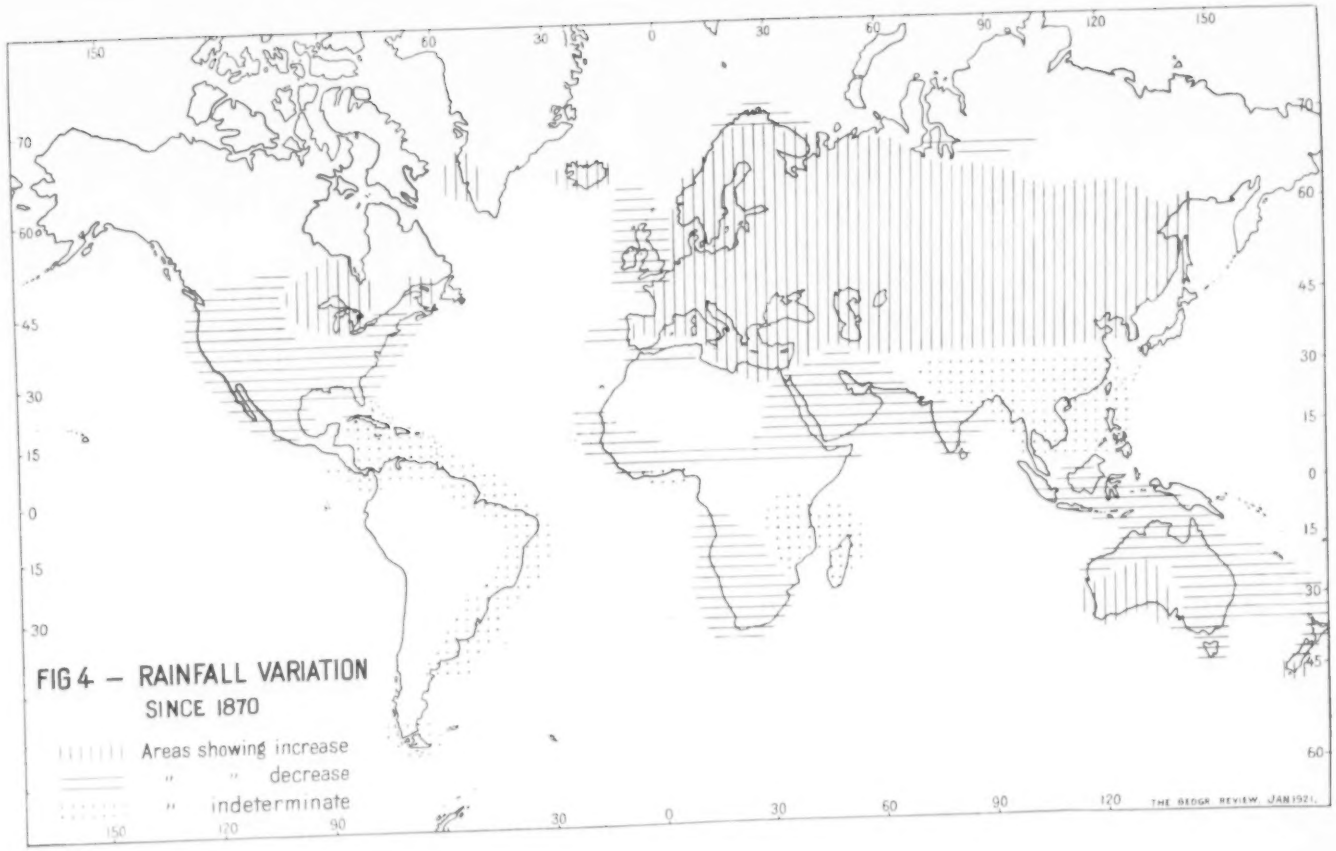
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FIG 4 — RAINFALL VARIATION
SINCE 1870
Areas showing increase
" " decrease
" indeterminate
THE GEOGR. REVIEW. JAN 1921.

Similar areas can be determined in the maps of pressure (Fig. 3) and rainfall (Fig. 4).

Now we have to bear in mind two important points:

1. A decrease in sun-spot numbers is closely associated with a decrease in the total amount of radiation emitted by the sun. Consequently since 1870 the solar radiation reaching the upper limit of the earth's atmosphere has been decreasing.

2. The world may be classified into two types of climatic areas:

   A. Dependent directly on the heat received from the sun—most of the tropics; Central Asia.

   B. Dependent more closely on variations in the atmospheric circulation —the temperate storm belts and the permanent subtropical anticyclonic regions.

Changes in Tropical Regions

Returning to Figure 2, we find a tendency for the equatorial regions to show a fall of temperature since 1870. This is of great interest, as it is conformable with the decrease of heat received at the limit of the earth's atmosphere, instead of being opposed to it as in the case of the eleven-year period. The theory of the latter is that owing to the peculiar properties and action of the earth's atmosphere, a small increase in the total heat received results in an actual decrease of temperature at the earth's surface. But obviously this process has limits, and even in the sun-spot period the minimum temperature occurs about two years before spot maximum. It seems that the much greater range of solar heat in the last forty or more years has sufficed to overpower this secondary effect and give the temperature variation in the tropics a course roughly parallel to that of the solar heat. But it will be seen later that where the sun-spot secular variation curve flattens out there is a tendency for the temperature to rise again in spite of the fall during the earlier period.

The chief exception to the progressive fall in the tropics is the monsoonal region of southeastern Asia. In the interior of Asia the decrease of temperature has been very marked. Figure 3 shows that the decrease of temperature in the equatorial regions has been accompanied very closely by a rise of pressure, and Figure 4 shows a corresponding decrease of rainfall. In both cases the relationship is obvious: the air has become colder; hence it has also become heavier, while evaporation and therefore rainfall have diminished.

Changes in Extratropical Regions

In the regions dependent chiefly on the variations of the atmospheric circulation the case is more complicated. The strength of the circulation in extratropical regions depends chiefly upon the relative intensity of the low-pressure centers in the cold temperate zone, compared with the subtropical

anticyclonic belts. The latter have shared in the equatorial rise of pressure, and, since the average pressure over the globe must remain approximately the same from year to year, this rise implies a corresponding decrease in higher latitudes. Consequently there should have been an increase in the poleward pressure gradient giving increased strength to the prevailing westerly winds of temperate latitudes. The map (Fig. 3) shows increases of pressure at Honolulu, over the West Indies anticyclonic region, and over northern Africa in the northern hemisphere; also over the subtropical high pressure belt in South America, South Africa, and northern Australia in the southern hemisphere. California seems to be an exception. On the other hand, there has been a fall of pressure in the Iceland-Greenland minimum and over the storm centers of Tierra del Fuego, Cape Colony, and the southern coast of Australia. So far so good.

Northwestern Europe

The relations of pressure variations to temperature and rainfall are shown best in the storm area of northwestern Europe. The marked decrease in the pressure at Iceland (60 units) and Greenland (71 units), combined with the increase over Europe, must have increased the strength of the southwesterly winds very considerably. The normal pressure difference between Iceland and southeastern England is about 12 millibars. During the last forty years this has increased at the average rate of about 0.1 mb. a year, a difference of 4 mb. between the first and last years of the series, which means that the resultant southwesterly current must have increased by almost 50 per cent during that period, a very important change. Hence a steady increase in the temperature of western Europe. The pressure decrease apparently extended into the Arctic Ocean (Vardo 9 units) and northern Siberia (Irkutsk 19, Yakutsk 20 units), and under its influence the belt of rising temperature passed right across the Siberian plain almost to the Pacific, its southern limit gradually shifting polewards on the way. There has been at the same time an increase of precipitation (except over the British Isles, which lose rainfall when depressions are able to pass rapidly northeastwards instead of hanging round the Atlantic coast). On the western side of the Iceland-Greenland minimum there must have been an increase of northerly winds, and a fall of temperature is shown. The increase of rainfall probably indicates an increased westerly or on-shore component in the wind.

Storm Belt of the Southern Hemisphere

In the storm belt of the southern hemisphere conditions are different in that there is no equatorial component in the wind, which is almost due west at Cape Horn and rather southwest at Cape Town and Perth, Western Australia. Consequently increasing the pressure gradient increases the cloudiness without bringing in warmer air, and a fall is shown in the temperature. Eastern Australia is an exception; here the wind normally comes from

lower latitudes, and there has been an increased northwesterly gradient; hence more warm air has come in and temperature has risen; but, as the air is from the dry interior, rainfall has decreased.

Temperate North America

Temperate North America shows rather curious conditions. There has been a definite rise of pressure, except for a slight fall in the coastal regions of California. This is part of the general rise over the continents. It is unfortunate that there is no long uniform series from Alaska. The normal pressure gradient favors northwesterly winds over North America, and the general trend of pressure changes since 1870 has been to weaken this gradient; hence higher temperatures. At the same time the more anticyclonic conditions caused a decrease of the rainfall, except in eastern Canada, which has come under the influence of easterly oceanic winds from the Atlantic, caused by the relative increase of pressure over the St. Lawrence estuary and bringing increased rainfall.

Monsoon Area of Southeastern Asia

A remarkable exception to the general trend of variation in the tropics is shown by the monsoon area of southeastern Asia. Instead of falling temperature, rising pressure, and decreasing rainfall, this unit shows rising temperature over approximately its whole area and, except in southern India, falling pressure and indeterminate rainfall. Southern India has apparently been unable entirely to throw off its tropical characteristics and shows indefinite pressure variations and decreasing rainfall. The cause of these exceptional variations is obscure but can reasonably be connected with the variations farther north. The general changes of pressure over Siberia indicate an increase of the westerly component of the wind and a decrease of the northerly component. This means that the cold air of northern Siberia is carried off eastward and that less of it penetrates to southern Asia as the northeasterly monsoon. This monsoon is the principal agent in lowering the temperature there. There results an increased average temperature in the regions subject to the northerly winds in winter, which in turn lowers the pressure. The gradient for the southerly monsoon becomes stronger, and this further raises the temperature and contends, though with only partial success, against the normal tendency of equatorial regions towards an increasing drought.

Practical Value of This Study

Having discussed briefly the extremely interesting principles of the mechanism of climatic changes raised by this study, a word may be said as to its practical value. It often happens in climatological work that a series of figures of, say, rainfall is not strictly homogeneous. There may have been a change of station from one part of the town to another. By means of an

overlapping period factors may be obtained for reducing the earlier series to the same conditions as the later. The reduction may appear to be sound, and yet some doubt may attach to the result. A single example will suffice. In the course of preparing normals for use in the *Reseau Mondial*, a rainfall series at Villa Colon (1883–1905) was combined with a later one at the Central Observatory (1901–1918) to obtain a long-period normal of rainfall at Montevideo. The overlapping period of five years should have sufficed, considering the near neighborhood of the two stations, but on completing the work the earlier series was found to show a considerably smaller rainfall than the later series. The figures actually were: 1883–1900, 32.0 inches a year; 1901–1918, 39.0 inches a year.

This indicates a value of b equal to + 0.4 inches, i.e. the rainfall has been increasing at the average rate of 0.4 inches a year. This is considerable and would have thrown suspicion on the accuracy of the reduction; but reference to the rainfall paper already cited showed for Buenos Aires a value of + 0.75 inches for b during the period 1861–1907. This sufficiently confirms the increase at Montevideo, and the long period normal was accepted. A similar method has been applied to many doubtful series, with great success in separating the sound from the unsound.

The values of the correlation coefficients given in Table II are not in general large. This was to be expected and merely shows that the amount of the average year to year change throughout the whole period is not sufficient to dominate the irregular fluctuations and variations of the short period. Considering the multiplicity of agents which affect climate, it would indeed have been surprising if any other result had been found. Even so, some very remarkable results may be noted. In the West Indies we have two concordant high values of pressure: + .75 at San Juan, Porto Rico, and + .78 at Havana, continued in a northwesterly direction by + .36 at Key West, + .33 at Galveston, and + .46 at Denver, Colo., and in a southeasterly direction by + .20 at Para and + .61 at Blumenau—the six stations having a mean value of + .56. In southeastern Asia we have − .60 at Manila, − .33 at Hongkong, and − .39 at Zikawei. An area of high positive coefficients is found in eastern and northern Australia. These are all tropical or subtropical regions where the irregular fluctuations reach a minimum; in higher latitudes the reverse is the case, but even here we have to notice − .48 at Jacobshavn and − .39 at Stykkisholm.

In the case of temperature the values are as a whole smaller, indicating greater irregularity in this element. The thirteen stations in northern Europe, which are all positive, have a mean value of only − .23. The highest numerical value is − .76 at Mauritius; but western and northern Australia have also some high negative values: − .70 at Carnarvon, − .31 at Alice Springs and Port Darwin, and − .59 at Perth—mean − .48. For rainfall I may quote a high positive area in central Siberia (mean of five stations + .54) and a highly negative area between Sierra Leone and the Azores (mean of four stations − .47).

TABLE II—RESULTS OF CORRELATION OF MEAN ANNUAL PRESSURE AND TEMPERATURES WITH TIME

STATION	LAT. Deg.	Min.	LONG. Deg.	Min.	PRESSURE No. Yrs.	σ	r	e	b	TEMPERATURE No. Yrs.	σ	r	e	b
						mb/100			mb/1000		°C			°C/1000
NORTH AMERICA	N		W											
Albany, N. Y.	42	39	73	45	39	74	+.11	.10	+2	36	0.84	+.18	.11	+13
Denver, Colo.	39	45	105	0	40	47	+.46	.08	+19	40	0.64	.00	.11	0
Galveston, Tex.	29	18	94	50	40	71	+.33	.09	+20	40	0.47	+.06	.10	+2
Helena, Mont.	46	34	112	4	31	54	+.22	.12	+13	33	0.75	+.08	.11	+7
Key West, Fla.	24	34	81	49	40	54	+.36	.09	+18	40	0.49	−.55	.07	−23
St. Louis, Mo.	38	38	90	12	..	....	.....	..	.....	40	0.72	+.17	.10	+11
San Diego, Cal.	32	43	117	10	40	57	−.07	.10	−3	40	0.52	−.07	.11	−4
Sydney, N. S.	46	10	60	10	36	90	+.43	.09	+36	36	0.74	+.14	.11	+10
Toronto	43	29	79	23	41	63	+.05	.10	+3	36	0.88	+.37	.09	+32
Victoria, B. C.	48	24	123	19	21	74	+.26	.14	+31	22	0.73	+.57	.10	+66
Washington, D. C.	38	54	77	3	40	69	−.20	.10	−12	40	0.57	−.19	.10	−9
Winnipeg, Man.	49	51	97	7	20	78	+.18	.14	+21	20	1.07	+.61	.10	+100
ICELAND, GREENLAND, AND FAROES														
Jacobshavn	69	13	51	2	42	180	−.48	.08	−71	38	1.41	−.05	.11	−6
Stykkisholm	65	5	22	46	42	185	−.39	.09	−60	42	0.78	+.27	.09	+17
Thorshavn	62	22	6	44	42	143	−.06	.10	−7	39	0.44	−.03	.11	−1
NORTHERN EUROPE														
Archangel	64	33	40	32 E	34	166	+.32	.10	+55	26	1.10	+.27	.12	+27
Basel	47	33	7	35 E	41	96	−.03	.10	−2	38	0.58	+.01	.11	+5
Christiansund	63	7	7	45 E	45	144	+.11	.10	+12	37	0.65	+.34	.10	+19
Greenwich	51	29	0	0	41	142	+.30	.09	+36	41	0.58	+.22	.10	+11
Hamburg	53	33	9	59 E	36	107	+.06	.11	+5	36	0.64	+.62	.07	+38
Kieff	50	26	30	31 E	..	....	.....	..	.....	38	0.81	+.19	.10	+14
Lugansk	48	35	39	20 E	..	....	.....	..	.....	35	0.86	+.33	.10	+28
Moscow	55	46	37	40 E	..	....	.....	..	.....	38	0.95	+.13	.11	+11
Petrograd	59	56	30	16 E	38	140	+.02	.11	+3	38	1.01	+.21	.10	+19
Valencia	51	56	10	15W	43	179	+.04	.10	+6	27	0.36	+.09	.13	+4
Vardo	70	22	31	8 E	42	155	−.07	.10	−9	39	0.78	+.13	.10	+9
Vienna	48	15	16	21 E	40	89	+.10	.10	+7	41	0.60	+.12	.10	+6
Warsaw	52	14	21	2 E	38	81	+.39	.09	+29	38	0.79	+.28	.10	+20
NORTHERN ASIA	N		E											
Astrachan	46	15	48	4	30	73	+.27	.11	+20	24	0.68	−.09	.13	−6
Barnaul	53	20	83	47	38	101	+.17	.10	+15	38	0.85	+.38	.09	+29
Ekaterinburg	56	50	60	38	..	....	.....	..	.....	38	0.77	+.18	.10	+13
Yeniseisk	58	27	92	6	34	148	+.02	.11	+3	34	1.09	+.40	.10	+40
Irgiz	49	30	60	18	..	....	.....	..	.....	27	0.90	+.17	.12	+20
Irkutsk	52	16	104	19	35	136	−.15	.11	−19	35	0.43	−.50	.08	−21
Yakutsk	62	1	129	43	19	101	−.12	.15	−20	19	0.81	+.03	.15	+4
Nikolaevsk	53	8	140	45	..	....	.....	..	.....	31	0.70	−.07	.12	−5
Obdorsk	66	31	66	35	..	....	.....	..	.....	25	1.40	+.41	.11	+77
Tashkent	41	20	69	18	30	108	−.11	.12	−11	30	0.73	−.28	.11	−19
Turukhansk	65	55	87	38	..	....	.....	..	.....	22	1.06	+.25	.13	+35
CENTRAL AMERICA AND WEST INDIES	N		W											
Barbados	13	8	59	40	29	51	+.13	.12	+7	..	...	.....	..	.....
Bermuda	32	18	64	47	29	88	−.33	.11	−32	..	...	.....	..	.....
Grenada	12	5	61	40	..	....	.....	..	.....	25	0.23	+.45	.11	+15
Havana	23	0	82	15	40	72	+.78	.04	+53	..	...	.....	..	.....
Mexico City	19	26	99	8	34	57	−.07	.11	−4	34	0.36	−.01	.11	−1
San Juan, Porto Rico	18	25	66	7	40	75	+.75	.05	+52	..	...	.....	..	.....
MEDITERRANEAN REGION AND ARABIA														
Aden	12	45	45	3 E	32	40	+.33	.11	+14	30	0.28	−.10	.12	−3
Lisbon	38	43	9	9W	40	81	+.51	.08	+55	28	0.58	+.49	.10	+35
Malta	35	54	14	31 E	..	....	.....	..	.....	30	0.51	−.03	.12	−1
Palermo	38	7	13	22 E	28	69	.00	.13	0	..	...	.....	..	.....
Ponta Delgada	37	45	25	41W	..	....	.....	..	.....	25	0.43	+.19	.13	+9
Rome	41	54	12	27 E	..	....	.....	..	.....	40	0.37	−.10	.10	−3
Skutari	41	0	29	3 E	33	69	−.28	.11	−10	33	0.56	−.03	.12	−2
Tiflis	41	43	44	48 E	38	55	+.35	.09	+18	38	0.62	−.51	.08	−29

TABLE II—(*Continued*)

STATION	LAT. Deg.	Min.	LONG. Deg.	Min.	PRESSURE No. Yrs.	σ	r	e	b	TEMPERATURE No. Yrs.	σ	r	e	b
						mb/100			mb/1000		°C			°C/1000
INDIA AND PERSIA	N		E											
Agra	27	10	78	5	39	49	−.25	.10	−11	39	0.49	+.09	.11	+4
Bagdad	33	21	44	28	17	41	+.04	.16	+3	21	0.72	+.21	.14	+23
Bombay	18	54	72	49	43	41	+.01	.10	0	36	0.34	+.46	.09	+15
Bushire	28	59	50	49	34	41	+.03	.11	+1	34	0.48	−.29	.10	−13
Calcutta	22	32	88	0	43	39	+.03	.10	+1	36	0.36	+.41	.09	+14
Colombo	6	56	79	32	44	41	+.11	.10	+4	39	0.31	+.24	.10	+7
Leh	34	10	77	42	34	83	+.50	.09	+41	36	0.77	−.52	.08	−37
Madras	13	4	80	14	43	44	−.14	.10	−5	36	0.30	+.45	.09	−13
Rangoon	16	46	96	13	38	43	+.20	.10	+8	38	0.36	+.09	.11	+3
SOUTHEASTERN ASIA														
Batavia	6	11 S	106	50	40	48	+.01	.10	0	40	0.49	+.38	.0	+16
Hongkong	22	18 N	114	11	28	47	−.33	.11	−19	28	0.35	+.50	.09	+21
Manila	14	35 N	120	58	34	59	−.60	.07	−35	34	0.45	−.54	.08	−25
Nagasaki	32	48 N	129	57	26	56	+.17	.13	+12	33	0.54	−.17	.11	−9
Peking	39	57 N	116	28	..	....	....	..	....	27	0.46	−.23	.12	−9
Tokyo	35	41 N	139	45	39	45	+.01	.11	0	36	0.47	+.03	.11	+2
Zikawei	31	12 N	119	6	37	44	−.39	.09	−16	37	0.41	+.15	.11	+6
SOUTH AMERICA NORTH OF 30°S.	S		W											
Bahia	12	54	38	24	20	20	+.12	.15	+4	20	0.53	−.25	.14	−23
Blumenau	26	55	49	3	20	174	+.61	.10	+182	20	0.58	−.50	.11	−51
Para	1	28	48	24	15	20	+.20	.17	+9	..	....	....	..	....
Recife	8	5	34	50	22	105	−.16	.14	−22	22	0.28	−.36	.12	−14
Rio de Janeiro	22	54	43	10	39	68	−.13	.10	−8	39	0.69	−.38	.09	−23
AFRICA NORTH OF 30°S.														
Abbassia	30	5 N	31	17 E	42	62	+.48	.08	+24	40	0.77	−.38	.09	−25
Algiers	36	48 N	3	2 E	24	68	+.42	.11	+41	24	0.54	+.03	.14	+2
Durban	29	51 S	30	30 E	34	71	−.66	.07	−49	33	0.60	+.26	.11	+16
Sierra Leone	8	30 N	13	9 W	..	....	....	..	....	30	0.48	−.30	.09	−13
Zanzibar	6	10 S	39	11 E	22	33	+.33	.13	+18	22	0.26	+.11	.14	+4
TROPICAL OCEANIC ISLANDS														
Honolulu	21	18 N	157	50 W	30	64	+.13	.12	+10	38	0.35	−.67	.06	−21
Malden Island	3	59 S	155	0 W	..	....	....	..	....	27	0.41	−.27	.12	−13
Mauritius	20	6 S	57	33 E	39	58	−.58	.07	−30	38	0.46	−.76	.05	−31
St. Helena	15	55 S	5	43 W	18	34	+.48	.12	+30	27	0.39	+.48	.10	+30
Seychelles	4	45 S	55	45 E	19	38	+.19	.15	+13	20	0.43	−.18	.14	−13
Teneriffe	28	25 N	16	32 W	30	72	−.46	.10	−28	..	....	....	..	....
AUSTRALIA NORTH OF 30°S.	S		E											
Alice Springs	23	38	133	37	31	74	−.06	.12	−4	30	0.71	−.31	.11	−22
Brisbane	27	28	153	6	27	88	+.27	.12	+30	27	0.34	+.59	.08	+26
Carnarvon	24	54	113	39	22	85	+.59	.09	+69	19	0.51	−.70	.08	−46
Derby	17	18	123	39	20	64	+.08	.15	+ 9	19	0.59	−.14	.15	−14
Port Darwin	12	28	130	51	32	81	+.54	.09	+47	36	0.47	−.31	.10	−14
SOUTHERN SOUTH AMERICA	S		W											
Buenos Aires	34	36	58	22	40	60	+.11	.10	+6	43	0.51	−.16	.10	−6
Córdoba	31	25	64	12	41	60	+.25	.10	+13	41	0.61	+.16	.10	+8
Punta Arenas	53	10	70	54	19	150	−.30	.14	−21	20	0.73	−.21	.14	−26
Santiago	33	30	70	30	43	48	+.06	.10	+2	43	0.49	+.07	.10	+3
SOUTH AFRICA	S		E											
Cape Town	33	56	18	29	33	37	−.05	.11	−2	31	0.30	−.37	.10	−12
AUSTRALASIA SOUTH OF 30°S.														
Adelaide	34	57	138	35	33	83	−.17	.11	−15	38	0.36	.00	.11	0
Albany, W. A.	35	2	117	53	24	88	−.31	.12	−41	..	....	....	..	....
Auckland	....		....		..	....	....	..	....	38	0.46	−.37	.09	−13
Perth	31	57	115	52	29	74	−.01	.12	−1	36	0.50	−.59	.07	−26
Sydney	33	52	151	12	43	96	+.47	.08	+37	43	0.25	+.20	.10	+4

The Governing Factor in Temperature Variation

Two interesting points which arose in the course of the work may be referred to. The first is the distribution of the variation of temperature with time between the mean daily maximum and the mean daily minimum temperatures. Long series were readily available for only three stations, St. Helena, Grenada (West Indies), and Sierra Leone.* These showed the following values:

		σ Degrees Centigrade	r	b Degrees Centigrade
St. Helena	Mean maximum	0.91	+.69	+.081
	Mean minimum	0.31	−.44	−.018
	Mean	0.39	+.48	+.031
Grenada	Mean maximum	0.34	+.39	+.018
	Mean minimum	0.21	+.45	+.013
	Mean	0.23	+.45	+.015
Sierra Leone	Mean maximum	0.53	−.59	−.023
	Mean minimum	0.70	−.05	−.003
	Mean	0.48	−.30	−.013

These three examples show that the governing factor in the temperature variation is the day temperature. In the case of St. Helena we have the remarkable fact that while the maximum temperatures have been increasing, the minima have been decreasing, giving an average increase in the daily range of one degree centigrade in ten years—an important climatological effect. At the other stations the variation of the minima is in the same direction as that of the maxima but is apparently less rapid. A general examination of the figures at seventeen tropical stations was made (see Table III), and, though the series are generally less than twenty years in length, certain facts could be definitely ascertained.

1. Stations may be divided roughly into two groups:
   - A. Tropical islands and continental stations in arid districts or at high levels.
   - B. Coastal stations.

2. At stations in group A the maxima vary much more than the minima; at coastal stations the ratio ranges about unity.

3. In group A the maxima alone show any marked relation to time, the value of b averaging about 0.14° F., i.e. the mean for the decade 1910–1919 is about 1.4 degrees higher than that for the decade 1900–1909.

It should be noted that the first period (average period about 1903–1909) is one of considerably higher sun-spot numbers than the second (about 1910–1915), which partly accounts for the general rise of temperature shown.

TABLE III—MEAN DAILY MAXIMUM AND MINIMUM TEMPERATURES AT TROPICAL STATIONS
(In degrees Fahrenheit)

	MEAN DAILY MAXIMUM			MEAN DAILY MINIMUM		
	1900–09	1910–19	CHANGE	1900–09	1910–19	CHANGE
A. ISLAND STATIONS						
Fanning Island	85.6	88.2	+2.6	76.7	76.6	−0.1
Malden Island	90.2	90.0	−0.2	75.0	74.3	−0.7
Ocean Island	89.2	88.3	−0.9	75.2	76.2	+1.0
St. Helena	66.3	68.7	+2.4	56.3	56.5	+0.2
Tulagi, Solomon Is.	84.7	87.7	+3.0	75.5	76.1	+0.6
Mean	83.2	84.6	+1.4	71.7	71.9	+0.2
INTERIOR STATIONS						
Entebbe	78.0	79.1	+1.1	63.2	62.8	−0.4
Kontagora	91.1	93.4	+2.3	68.7	67.9	−0.8
Maiduguri	97.5	97.8	+0.3	67.3	68.3	+1.0
Yola	91.8	93.6	+1.8	70.9	72.2	+1.3
Zungeru	92.2	93.1	+0.9	70.1	70.3	+0.2
Mean	90.1	91.4	+1.3	68.0	68.3	+0.3
B. COASTAL STATIONS						
Accra	85.2	85.4	+0.2	72.4	72.3	−0.1
Bathurst	85.7	86.0	+0.3	69.9	68.9	−1.0
Cape Coast Castle	85.5	85.4	−0.1	73.3	71.5	−1.8
Grenada	83.8	84.0	+0.2	73.9	74.2	+0.3
Lagos	86.3	86.9	+0.6	75.0	74.8	−0.2
Sandakan, Borneo	88.5	88.7	+0.2	75.5	75.4	−0.1
Sierra Leone	88.2	88.1	−0.1	73.4	72.8	−0.6
Mean	86.2	86.4	+0.2	73.3	72.8	−0.5

NOTE. The series mostly begin about 1903 or 1904 and end about 1917.

TENDENCY TOWARD DECREASING DEVIATION FROM NORMAL

The second point is the remarkable tendency which has existed during the last forty years for a numerical decrease in the deviations from normal. This has been brought out by dividing the whole period at each station into two halves and summing the squares of the deviations independently in each half. Calling the standard deviation of the first period A and that of the second period B, we find the following distribution (only long complete series were used):

		B greater than A B/A			A greater than B A/B		
		>2	2−1.33	1.33−1	1−1.33	1.33−2	>2
Pressure	Number	0	9	7	9	21	12
	Per cent	0	15	12	16	36	21
Temperature	Number	2	5	9	19	13	7
	Per cent	4	9	16	35	23	13

The phenomenon is most marked in the case of pressure, where in 33 cases, or 44 per cent, the standard deviation in the first period exceeded that in the second by at least 33 per cent, while in 12 cases the excess was at least 100 per cent. In temperature the distribution is less striking; but in 71 per cent the deviation in the first period exceeded that in the second and was more than double it in 13 per cent, compared with only 4 per cent when it was less than half. The individual stations were as follows:

Pressure: B/A 2–1.33: Abbassia, Aden, Córdoba, Denver, Galveston, Hamburg, St. Helena, Jacobshavn, Mexico City.

B/A 1.33–1: Basel, Bushire, Leh, Lisbon, Port Darwin, Vienna, Warsaw.

A/B 1–1.33: Batavia, Colombo, Havana, Hongkong, Manila, Skutari, Stykkisholm, Tokyo, Valencia.

A/B 1.33–2: Adelaide, Albany (N. Y.), Archangel, Barnaul, Bombay, Buenos Aires, Calcutta, Cape Town, Christiansund, Honolulu, Mauritius, Perth (W. A.), Petrograd, San Diego, San Juan, (P. R.), Sydney (Nova Scotia), Thorshavn, Tiflis, Toronto, Washington, Zikawei.

A/B more than 2: Agra, Durban, Yeniseisk, Greenwich, Irkutsk, Key West, Lugansk, Rangoon, Rio de Janeiro, Santiago, Sydney (N.S.W.), Vardo.

Temperature: B/A more than 2: Adelaide, Buenos Aires.

B/A 2–1.33: Colombo, Córdoba, Denver, Galveston, Mexico City.

B/A 1.33–1: Bombay, Greenwich, St. Helena, Honolulu, Irkutsk, Jacobshavn, Lugansk, St. Louis, Washington.

A/B 1–1.33: Agra, Archangel, Barnaul, Batavia, Calcutta, Ekaterinburg, Hamburg, Hongkong, Key West, Madras, Manila, Mauritius, Moscow, Petrograd, Port Darwin, San Diego, Sydney (Nova Scotia), Vardo, Zikawei.

A/B 1.33–2: Basel, Cape Town, Christiansund, Kieff, Leh, Nagasaki, Rio de Janeiro, Stykkisholm, Sydney (N.S.W.), Tiflis, Tokyo, Toronto, Vienna.

A/B more than 2: Abbassia, Yeniseisk, Perth (W.A.), Rangoon, Santiago, Thorshavn, Warsaw.

This list shows that both with pressure and temperature the preponderant standard deviation of the earlier years is found chiefly in the belt of decreasing pressure over northern Europe and Siberia and also in India, the West Indies, the New England states, and the eastern coast of Australia. The reverse, B greater than A, is more restricted, being found chiefly in the Mediterranean region and the interior of America. These facts are of great interest; they may be paralleled with the investigations of J. von Hann and Liznar, who found that the absolute variability of temperature as shown by the annual range is greater at times of spot maximum than at spot minimum. A similar result for the range of daily maximum temperatures was found by MacDowall for Geneva. No similar direct results for pressure anomalies have been discovered, but there is a classical paper by Meldrum in which he shows that the cyclones of the Indian Ocean have a marked maximum frequency at spot maximum and minimum frequency at spot minimum. Similar results have been obtained by Poey in the Antilles, and these phenomena may be considered as analogous to the decreasing pressure irregularities with decreasing sun-spot numbers. The two exceptions, the Mediterranean and the interior of the United States, are apparently due to a

tendency of depressions to follow more southerly tracks at times of few sun spots, thus increasing the variation of pressure and temperature in the regions traversed by these tracks.

Conclusion

Finally, I must admit that the results set out in this paper need to be considered as a preliminary survey only. For the tropical islands especially the series of observations are rarely long enough for such a statistical investigation, though for the purpose of a comparison of solar and terrestrial changes these islands are of great importance as giving relatively simple conditions. But, when it is seen that secular trend may appreciably modify the climate of a place within the relatively short period of forty years, I hope that investigators of the climatic conditions of various localities will realize the importance of this element of climate and, with fuller information at their command, will check the accuracy of the results or fill in the details at present necessarily left blank.

THE CHICAGO MEETING OF THE ASSOCIATION OF AMERICAN GEOGRAPHERS

The sixteenth annual meeting of the Association of American Geographers was held in Chicago on Thursday, Friday, and Saturday, December 30–31, 1920, and January 1, 1921. Doubtless all who were present would vote the program of this meeting one of the most interesting in the history of the Association. The first group of papers was meteorological and climatological in character. Prof. O. L. Fassig described the organization of the climatological service of the West Indies, illustrating his paper with charts showing the location of stations and the comparative value of the data by regions. Dr. C. F. Brooks referred to recent observations on the well-known appearance of cold surf with off-shore winds. Professor Jefferson remarked, in discussion, that the phenomenon of cold water with off-shore winds was not associated with surf on the Great Lakes—that surf appeared only with on-shore winds and involved relatively warm water. Dr. Forrest Shreve read a paper entitled "Vertical Gradients of Evaporation and Soil Moisture in Desert and Coastal Mountains." He emphasized the point that in coastal mountains the physical conditions were more severe with increase of elevation, while the opposite is true of desert mountains. He solicited the coöperation of other investigators in obtaining similar data elsewhere. Dr. Shreve finds that soil moisture and evaporation conditions rather than rainfall are the vegetal determinants in the Southwest.

A general review of the work of the non-magnetic yacht *Carnegie* was given by Dr. L. A. Bauer in a paper entitled "The Status of the General Magnetic Survey of the Earth." The path of the *Carnegie* as well as the records of land explorers were represented, and the interesting point made that the total length of the *Carnegie's* cruises represents a distance equal to that from the earth to the moon and 100,000 miles beyond.

Prof. R. S. Holway's paper on "Stream and Ocean Terraces in Relation to Recent Earth Movements" was illustrated with unusually clear photographs of the terraced coast of California and dealt with detailed comparative measurements of stream and ocean terraces. The principal technical refinement was the allowance made for the obscuring effects of gravel deposits. The chief point in Prof. W. H. Hobbs' paper, "A Significant Contrast between the Atlantic and Pacific Regions" was the unequal ratio of crustal uplift between the Pacific and the Atlantic, a ratio tentatively estimated at 15:1. In connection with his coastal profiles Professor Hobbs exhibited Barrell's diagram of the broad and now dissected marine terraces of southern New England as published in the *American Journal of Science* (Pl. V, June, 1920). It is Professor Hobbs' view that the rise of the Pacific coastal terraces is caused by underthrust in the coastal belt originated by the downdropping of the Pacific Ocean floor.

Two papers, one by Mr. O. E. Baker on "The Importance and Permanence of the Physical Factors in Determining the Utilization of Land for Agricultural and Forest Production," and the other by Prof. C. O. Sauer on "Problems of Land Classification," illustrate the scope of the work now going forward in soil geography and in the geography of land classification. Miss Zonia Baber, through the medium of excellent diagrams, made a very clear presentation of the mathematical relations of the "Distribution of Sunlight and Moonlight over the Earth." In addition to their educational appeal the diagrams brought out the amelioration of the Arctic night afforded by moonlight.

Prof. Mark Jefferson's paper, "Chile: A Land where Immigrants Need not Apply," was undoubtedly the most brilliant paper of the session. With keen insight into the human conditions and reactions, and with rare judgment in the handling of the facts, Professor Jefferson traced in a masterly way the geographical conditions of German settlement in Chile. In preparation for his main point he emphasized particularly the high density of

population and high productivity per unit of area of cereals, potatoes, etc., as compared with the Argentine, the United States, and France, of that part of Chile *where most of the people actually live*, which is a very tiny section lying principally between Concepción and Valparaiso. This concludes the review of the principal papers during the Thursday sessions.

On Friday the session was opened by Dr. D. T. MacDougall's paper on "The Relation of Plants to New Habitats," in which the author gave his methods and results in transplanting a large number of species from high mountain slopes to lowland localities and vice versa. Some of the transplanted forms are then returned to their original habitat to see what manners, customs, and other special characteristics they retain after their trip abroad. The author referred to Bonnier's classic paper on the transplanting of alpine forms to lowland localities and criticized Bonnier's method, which consisted in part of the actual transplantation of the soils in which the plants grew. Dr. MacDougall felt that this implied a false exactness, since soils are not definite quantities that form a fixed habitat, but are in every case a reaction in part to climate, soil organisms, etc.

One of the most interesting papers on the program was "Ecology and Geographic Boundaries," by Prof. H. C. Cowles, who sketched the ecologic basis of the disputes in the sunk lands region of eastern Arkansas affected by the New Madrid earthquakes of 1811–1812. The paper clearly demonstrated the great progress made in recent years in the study of the physiographic conditions that affect rings of growth and the variation in ring habit among different kinds of trees. Temperature, light, and rainfall all produce a composite effect, and rain does not always have its chief effect in the years in which it falls. The author referred to the importance of ecological studies in decisions bearing on the validity of titles to timber lands and oil fields, and on the present standing of ecology in decisions in the Land Office and the courts. The use of rings of growth is most striking in the case of surveyors' records cut into the trees at the time the surveys were made, and overgrown by new tissue which forms very definite casts of the surveyors' record, well preserved even long after the original record has disappeared by decay. By counting the number of rings since the tree was blazed and the cast made, the original date of survey may be checked or even determined.

Dr. V. C. Finch gave a paper entitled "The Significance of Vegetable Oils in the Economic Development of the Tropics," in which he pointed out the increasing American demand, as well as world demand, for vegetable oils now in use, and of which a considerable number are produced in the temperate zone in competition with temperate crops. The tropical oils are not in such competition with local production. While the demand has increased production, yet if the oil products of the temperate zone are crowded out or limited the question arises, can the tropics meet the demand? The interrelations of climatic and economic factors such as transportation, labor circumstances, topography and soils were indicated. The author concluded that if any crops are likely to succeed in the tropics it would be tree crops under a plantation system of management, because the only limiting factor there is that of market. There are no geographic factors in the tropics to prevent an indefinite increase.

Prof. R. E. Dodge read a paper entitled "Geographic Factors in Dairy Farming in Southern New England." After a preliminary statement of the general problem, there followed a detailed description of conditions in the town of Goshen, 1300 feet above sea level, west of Naugatuck Valley. He compared the conditions of 1845 with those of 1915–1917 in agriculture and dairying. Agricultural and livestock products have fallen off greatly and dairying and poultry products have come in as the cash products of the farm. By these processes the New England farmer has freed himself from bondage to the West. There is still a great difference in local conditions, prices, etc., among different communities that have not yet been brought within the scope of the organized system of market supply involving the large cities. Prof. C. O. Sauer gave a second paper in which he discussed the question of regional economics, of commercial production, and of the movements and commodities of trade. He analyzed the meaning of location in the economic sense, human adjustments to outworn economic conditions, and the value of type studies as illustrations. He raised the question as to what constitutes a geographical map and pointed out that the study of rural areas in-

volves a technique of which we are at present ignorant. How are cities to be studied? What is the proper definition of agricultural geography? He referred to the Dutch agricultural census arranged by geographical divisions.

In "The Grain Trade of Ancient Athens" Miss E. C. Semple gave a most valuable account of the close dependence of Greek material life upon imported food supplies, chiefly grain from the northern border of the Black Sea. The result was an anxious outlook upon forces that threatened her sea power and the security of the sea lanes, particularly the Hellespont.

On Friday evening, December 31, the Geographic Society of Chicago very hospitably entertained the members of the Association of American Geographers at a dinner at the Hotel Sherman. President Harry P. Pearsons of the Geographic Society of Chicago presided and Prof. R. D. Salisbury of the University of Chicago was toastmaster. After the dinner brief addresses were given by the following: Prof. H. E. Gregory of Yale University, "Geography and Good Fellowship;" Prof. C. O. Sauer of the University of Michigan, "The Association and the Isolated Geographer;" Dr. Isaiah Bowman of the American Geographical Society, "Political Geography in the Field of Diplomacy;" Prof. H. H. Barrows of the University of Chicago, "Geography and Legislation."

In Saturday's session there were given a group of papers dealing principally with the geographic conditions of a number of well-marked regions. Mr. F. W. Frostic discussed the history of settlement and the economic development of the Saginaw Valley region. The Fisheries of the Far East, their present low state of development, and the opportunities for American capital were discussed by Prof. F. J. Novakovsky. Prof. R. H. Whitbeck read a paper on the geography of Cuba, emphasizing the advantages of American influence and the probable relapse into disorder if the Cuban people were left to their own devices. Prof. N. A. Bengtson described the physiography and present economic condition of Honduras. Mr. H. C. McMurry explained the retarded development of Nashville which he ascribed to the fact that it is the focus of a small region, the central Tennessee basin; and that other potential regions outside the region are tributary to other foci—Memphis, Louisville, Cincinnati, and Birmingham. In discussion Mr. O. E. Baker justified the view that Nashville is the Athens of the South, by saying that it is the second city in the United States (after Boston-Cambridge) in the number of persons mentioned in Who's Who.

After these regional papers Mr. W. L. G. Joerg gave an account of "Bering's Two Expeditions to Determine the Relation of America to Asia." Mr. Joerg described Bering's first and second expeditions which were in the field from 1725 to 1730, and 1733 to 1741 respectively. His paper was illustrated by two wall maps, one giving a modern interpretation of the land and sea route of Bering's first expedition, the other representing a reconstruction by Bertholf of the tracks of the *St. Peter* (Bering) and the *St. Paul* (Chirikov) on the second expedition.

GEOGRAPHICAL RECORD

AMERICAN GEOGRAPHICAL SOCIETY

The General and Technical Meetings. On December 14th at 8:30 P. M. Baron de Geer addressed the Society on the subject of "Geochronology and its Application to Physical Geography." It was the first of a series of special lectures to be given during the winter season at the Society's building, Broadway at 156th Street. These lectures will be of a more technical nature, affording opportunity for the exhibition of appropriate illustrative material and taking the place of the former intermonthly meetings held at the Engineering Societies' Building, 29 West 39th Street. The regular monthly meetings of the Society will be held as usual in the auditorium of the Engineering Societies' Building and will retain their character of general interest.

Mr. Roy C. Andrews, of the American Museum of Natural History, opened the lecture program for the year on November 23, 1920. On December 21 Dr. Alexander Hamilton Rice gave the second lecture. In January the Society will hear Mr. Robert Cushman Murphy, of the Brooklyn Museum. His lecture is entitled "The Humboldt Current and the Islands of Peru." In February Professor Robert F. Griggs, of Ohio State University, will deliver an illustrated lecture on Katmai Volcano, Alaska. Announcement will be made at a later time of the remaining lectures to be given in March and April.

Address by Baron Gerard de Geer on Post-Glacial Chronology. Baron Gerard de Geer is Professor of Geology at the University of Stockholm. He has just concluded a visit to North America for the purpose of supplementing his extensive studies of Scandinavia and Spitsbergen in the field of post-glacial chronology. By a detailed study of the laminae of clay beds deposited in fresh water, Professor de Geer was able to discover seasonal effects, so that he could count the years during which the deposit had been made. Thus by a careful selection of localities and by matching variations in widely separated deposits, he was able to piece together the post-glacial record, including the retreatal stages of the ice sheet in Scandinavia. Professor de Geer then carried his studies into Spitsbergen, where they took on a somewhat different form; and with the help of an assistant he has studied deposits in northeastern North America in an effort to correlate the chief historical events of the late-glacial and post-glacial epochs with the events of similar epochs in Scandinavia.

The results are in every way gratifying. The correspondences are quite convincing, and there is thus held out the prospect that a more detailed and far more reliable chronology than existed hitherto may be worked out. Not the least interesting of Baron de Geer's observations was the one dealing with the possibility of correlating the latter part of the clay record with the earlier part of the tree record discovered by Professor Douglass and later worked out in great detail by Professor Huntington in Carnegie Institution Publication No. 192. It would be an extremely interesting thing to match the clay record of a recent period with the record of the rings of growth of the trees of the latest period, thus providing a complete chronology from late glacial times right into the present. This introduction of the time factor has a wide application in the field of physical geography. Where the recession of the former ice sheet has been determined the rate of evolutionary processes can be established. For instance it has been shown that in central Scandinavia the land has been uplifted some 900 feet in the last 8,500 years at a decreasing rate that has been determined century by century. At the same time the changes in the rate of melting of the ice afford a most remarkable register of the annual variation in the amount of heat received from the sun, thus extending the field of investigation of climatic evolution from terrestrial to astrophysical causes.

Presentation of the David Livingstone Centenary Medal to Dr. Alexander Hamilton Rice and Lecture by Dr. Rice. Dr. Rice's lecture dealt with his latest journey up the Rio Negro, through the Casiquiare Canal, and the upper waters of the Orinoco. Before the lecture Dr. Rice was presented the David Livingstone Centenary Medal, founded by the Hispanic Society of America and awarded by the American Geographical Society. Dr. Rice is the sixth recipient of the medal, the earlier recipients being Sir Douglas Mawson,

Theodore Roosevelt, Manuel Vicente Ballivián, Candido Mariano da Silva Rondon, and William Speirs Bruce. In presenting the medal President Greenough spoke as follows:

"It is now my pleasing duty as your President to bestow your gold medal upon a most worthy recipient. The resolution of award by the Council reads as follows:

TO
ALEXANDER HAMILTON RICE
1920

> Specially equipped for pioneer work in exploration he chose for his field various tributaries of the Amazon, hitherto unknown. In six successive journeys he surveyed large portions of the Rio Negro; the Solimões, the Uaupes, the Içana, and Iniridi, the Casiquiare Canal, and the Upper Orinoco. He has also maintained a school at São Gabriel for the education of the natives and devoted himself to a fundamental understanding of the life of northwestern Amazonas.

"This brief text serves as an index to the extensive and valuable services which the explorer has rendered to geographical science. When we realize that the Amazon Valley has 30,000 miles of navigable waterway, we can appreciate that many of these are still a sealed book to civilized mankind. Our guest has not only defined the great watercourses of the unknown regions which he visited, but he has investigated thoroughly the adjacent country, its topography, and its native population. The perils of such adventures are illustrated in the case of our lamented colleague the late Colonel Roosevelt, whose life was undoubtedly shortened by illness contracted in his journey down one of the tributaries of the great river.

"All the data acquired on his expeditions have been reduced by Dr. Rice to complete scientific order and record, thus rendering them available for further research; and he has pursued his important work with modest devotion to his quest, free from any public exploitation or advertisement. Such a bearing adds to the satisfaction which the Society may well feel in according suitable recognition to a notable accomplishment.

"And now, Sir, on behalf of the Society I ask your acceptance of this memorial of your distinguished efforts in the past, accompanied by the good wishes of all our Fellows for your welfare and success in your future undertakings."

After explaining his methods of survey in northwestern Amazonas, where he has explored a large region during the past thirteen years, Dr. Rice described the difficulties of the journey up the headwaters of the Rio Negro to the Casiquiare Canal, illustrating his description with many slides depicting the life of the natives. After a description of the Canal, which connects the headwaters of the Rio Negro and the Orinoco, Dr. Rice came to the climax of his account—the attack by savages upon his camp on the Orinoco east of the Canal. He was obliged to keep up a running fight with them for some hours and was lucky enough to escape with his life. The incident required him to leave incomplete a part of the original program.

NORTH AMERICA

The Population of Porto Rico. A preliminary bulletin issued by the Fourteenth Census (1920) shows that the total population of Porto Rico has increased from 1,118,012 in 1910 to 1,297,772 in 1920 or at a rate (16.1 per cent) corresponding very closely to the rate for the preceding decade. Though on the whole this increase has progressed with fair uniformity throughout the larger part of the island, it is more noticeable in the area lying south of and tributary to San Juan than elsewhere. The density of population is 325.5 per square mile, the equivalent of that of a large portion of the Po valley. If the present rate of increase keeps up, the problem of over-population is likely to become even more and more serious in the future. (F. K. Fleagle: Social Problems in Porto Rico, 1917.)

Visitors have often observed that the population is distributed with remarkable evenness over almost the entire surface of the island. Except for San Juan with 70,707 inhabitants and Ponce with 41,561, there are no towns of over 20,000 and the majority of the people dwell in the open country. Only 21.8 per cent live in towns or villages of more than 2,500, and 73.5 per cent live in rural districts not a part of any village. Nor has there been any appreciable displacement of the people from country to town. Between 1899 and 1910, probably as an immediate result of the American occupation, the proportion of town to

country dwellers rose from 14.6 per cent to 20.1 per cent, or 5.5 per cent of the total; but in the last decade urban centers of over 2,500 gained only 2 per cent.

SOUTH AMERICA

The Patagonian Forests. The Patagonian forests extending from latitude 33° S. (in the coastal mountains of Chile) to latitude 55° S. (Cape Horn), a distance of some 1,500 miles, form the subject of a report published by the Argentine Ministry of Agriculture (Max. Rothkugel: Los Bosques Patagonicos, Buenos Aires, 1916).

This long but narrow region is divided into three subregions: (1) Humid (rain) forests with many species, (2) humid (rain) forests with few species, (3) pure forests to the east and north of the humid forests.

The humid forests with many species extend from latitude 38° S. (near Victoria, Chile) to latitude 48° S. (mouth of Rio Baker). The region has a rainfall of between 80 and 120 inches and lies west of the axis of the Andes mostly on the Chilean side, though, mainly because the boundary line between Chile and Argentina does not coincide with the watershed, patches of the forests extend into Argentina. While the climate of this region varies according to latitude and altitude, it is generally mild with little or no snow or frost on the coast and with a fairly equable temperature throughout the year. At higher altitudes, where the forest occurs in the valleys, the climate is of course more severe. Nevertheless the conditions are such that the forest consists of a mixture of many species with an undergrowth that suggests subtropical rather than "antarctic" conditions, as is suggested by the designation often applied to the floral region of the Patagonian forests (Griesbach). Indeed one author, Warming, classified it as "subtropical," and Schimper calls it a "temperate rain forest." The principal trees of the region are the evergreen beeches (*Nothofagus*) and certain conifers (*Libocedrus*, *Fitzroya*, *Podocarpus*, and *Saxegothea*). The principal commercial timbers are *roble* (*Nothofagus obliqua*), *rauli* (*Nothofagus procera*), *coihue* (*Nothofagus Dombeyi*), *cipres* (*Libocedrus chilensis*), *alerce* (*Fitzroya patagonica*), and others.

The northern part of the forest region in Chile has been mostly cut over by the lumbermen and for agricultural purposes.

The humid forests with few species lie from south latitude 48° to Cape Horn. This region has a colder climate than the region to the north, with generally the same rainfall conditions. The index species of this region is *guindo* (*Nothofagus betuloides*) mixed with others, though the composition of the forest is not so complex. It has undergrowth species.

The pure forests extend in a narrow belt mostly on the Argentina side from Tierra del Fuego to the northern part of the territory of Neuquén, a distance of 1,100 miles. Here the characteristic species are *lengue* (*Nothofagus pumila*) and *ñire* (*Nothofagus antarctica*), usually occurring in almost pure stands. In Chile the region continues north of the humid region in the high valleys of the Andes, to 35° S. latitude and in the coastal mountains to 33° S. latitude. Besides *ñire* and *lengue* these forests contain roble. The pure forests are the expression of a drier climate and grade off into the non-forested regions of the east and north. In Argentina at the south they are found from sea level to 2,000 feet altitude and at the north from 4,000 to 6,000 feet altitude.

The subregion of the Chilean pine (*Araucaria imbricata*), known in Argentina as *pino de Neuquén*, lies in the Andes well to the north, from near 37° S. latitude to about 40° S. latitude, with a detached area in the Nahualbuta section of the coastal mountains of Chile between 37° and 38° S. latitude. There are two types of this; one pure, lying mostly on the Argentina side, and one mixed with other species, mostly in Chile. In Argentina the altitudinal range of the Chilean pine is from 2,100 feet above sea level at 40° S. latitude to about 6,000 feet at 37° S. latitude. The Argentina portion of the Araucarian forest covers some 200,000 acres, and is very inaccessible at the present time.

The Patagonian forest area of Argentina (with which the report is primarily concerned), covering nearly 10,000 square miles of intact forest, has no commercial value at present. But the forest is highly important as a protective cover. As Bailey Willis (Northern Patagonia) has shown, some of the adjacent semidesert land is susceptible of irrigation with the proper protection of the forested watersheds. If properly managed it would do this and be able to furnish continuous crops of timber for the inhabitants of the country. Steps have been taken by the Argentine government for the protection of the forests, and the introduction of economically valuable species of trees is being considered.

H. N. WHITFORD

EUROPE

The Italian-Yugo-Slav Boundary and the Free State of Fiume. The treaty of Rapallo (Rapallo is a few miles east of Genoa) signed November 10 establishes the boundary between Italy and the Serb-Croat-Slovene Kingdom and creates the Free State of Fiume. The text of the treaty is published in *Il Messaggero* for November 13, 1920.

Italy gains practically her maximum demands in the "irredenta" of Julian Venetia (see the review of Tamaro's "La Vénétie Julienne" on p. 153). The treaty of London line has here been the base of further concessions. This line it will be recalled ran from Mt. Tarvis along the watershed (Julian Alps) between the Isonzo and Save basins to the pass of Idria (leaving the famous mercury mines in Italian territory), thence across the forealpine and karst country towards the Schneeberg (Mt. Nevoso) "in such a way as not to include the basin of the Save and its tributaries in Italian territory," thence to the head of the Quarnero west of Fiume. The accompanying map shows the deviations from this line. Italy acquires the town of Tarvis (a strategic point commanding routes northeast to the Drave, west over the Saifnitz (Camporosso) pass to the Tagliamento and south over the Predil pass to the Isonzo. East and south of Idria Italy gains a considerable territory including the town of Adelsberg whereby the frontier is pushed well towards Laibach. From the eastern slopes of the Schneeberg the line swings southwestwards to meet the northern boundary of the Free State of Fiume a short distance southwest of Castua. Of Istrian territory Italy also acquires the islands of Cherzo and Lussin and the small islands and rocks included in their judicial districts.

FIG. 1—The boundary between Italy and the Serb-Croat-Slovene Kingdom according to the Treaty of Rapallo.

Italian sovereignty in Dalmatia is limited to a territory about Zara including the city and the fiscal commune, the adjoining fiscal communes of Borgo Erizzo, Cerno, Boccagnazzo and a part of Diclo. Special arrangements will be made to provide for reciprocal relations between this territory and the rest of the territory formerly belonging to the "commune, district and province." This will include equal division of the provincial and communal property and archives.

The islands of Lagosta and Pelagosa with the adjacent islets go to Italy. All the other Dalmatian islands are recognized as forming part of the Serb-Croat-Slovene Kingdom.

The State of Fiume is recognized as independent. It comprises the "corpus separatum"

delimited by the boundaries of the city and district of Fiume and a strip of former Istrian territory along the Gulf of Fiume. This strip which averages a kilometer and a half in width provides an unbroken route from the free city to contiguous Italian territory, one of the prime conditions of the Italian diplomatic program ever since the summer of 1919.

Natural Political Divisions of the Scandinavian Countries. The general tendency to reconstruction, resulting from the war, has found an expression in many of the European countries in the desire for internal political and economic readjustment. In the *Geographical Review*, Vol. 7, 1919, pp. 114–118, various proposals for changing existing administrative subdivisions, notably those of England, France, and Germany, were discussed. In line with this general tendency is Professor Sten de Geer's suggestion, developed in an article in *Ymer*, which contemplates the redistribution of the subdivisions of Fenno-Scandia and Denmark in general and of Sweden in detail.

FIG. 1—Proposed political divisions of the Scandinavian countries. Reproduced from the article abstracted in the text.

The proposed plan reduces to eight the present twenty-five provinces of Sweden. The proposed provinces are founded upon geomorphological, hydrographic, and climatic bases with due regard for biogeographic and anthropogeographic factors, a consideration of their historical development and the groupings of population. They are units of production, transportation, and commerce; and as a rule they have about equal population. That the boundaries of these provinces cannot conform to all factors is evident, but the transgressions of any one determining factor upon another are remarkably few and relatively insignificant.

By Professor de Geer's proposed division, Öfvernorrland and Nedernorrland comprise the northern and southern halves of the northern third of Sweden; Bergslagen and Mälarelandet, the western and eastern halves of central Sweden; Västkustlandet, Östkustlandet, and Skåne, comprise the southern portion; and Gottland becomes a distinct island province despite the rather close relation to the neighboring mainland.

The five southern provinces are fundamentally based upon distinct geomorphological characteristics. The three northern provinces are comprised within the sharply defined physiographic unit, Norrland, which is geomorphologically and biogeographically a distinct area. The southern boundary of Norrland is the northern limit of the oak, fruit trees, and pure agriculture; it is the southern limit of heavy snow, arctic winter, and lumbering. Delimitation of the provinces is largely determined by the watersheds.

The provinces thus defined are readily adaptable to the needs of administrative control. In this connection De Geer discusses them in relation to judicial, ecclesiastic, and military government, and argues for the relatively slight changes which his proposed system would necessitate. Though these changes would benefit both the judiciary and the church somewhat, it is the military strength of the nation which would best be served and promoted, particularly if the man power of each new province be duly considered. The final argument for the proposed subdivisions is based upon economic factors. The postal service, the railway systems, and movements of trade accord well with the new system.

The possibilities for the establishment of like rational provinces in the neighboring Scandinavian countries are briefly discussed. In Norway such a subdivision is readily established and easily justified. Norway is subdivided into the six provinces; Nordlandet, Trøndelagen, Västlandet, and the three districts—Oplandet, Kristianialandet, and Sörlandet—of Östlandet. Of these the three first named front upon the Atlantic and are definite natural divisions. They vary considerably in population but yet not so much so that serious objection may be raised on this ground. The three districts of Östlandet are a natural gemorphological unit, but because if united they contain over half the population of Norway, their retention as subdivisions is considered desirable.

These subdivisions of Norway accord very well with those proposed for Sweden: Nordlandet corresponds to Öfvernorrland naturally and culturally; the southern boundary of one is a continuation of the southern boundary of the other. The two provinces are connected by railway from Luleå to Narvik. Similarly, Trondelagan corresponds to Nedernorrland. These divisions are connected by railway from Sundsvall, in Nedernorrland, to Trondjhem. Oplandet in Norway corresponds to Bergslagen in Sweden. These two provinces lack seacoast, the only provinces in Scandinavia which do not front salt water. Further correspondence between the subdivisions of the two countries may be found in Kristianialandet and Sörlandet to Västkustlandet, and in Västlandet to Östkustlandet. These southern provinces are connected by railway and are industrially analogous.

FIG. 1—Proposed geographic regions of Sweden. Reproduced from the article abstracted in the text.

Finland is divided into Nordfinland, similar to the northern provinces of Norway and Sweden; Sydfinland, roughly accordant with the southern provinces of the peninsula; and an inland province, Sjölandet, the great lake district of Finland, which may be compared with the lake district of Sweden, though the latter is not defined as a province.

Denmark must be subdivided on the basis of factors quite different from those considered in the rest of Scandinavia. Two principal divisions at once suggest themselves—the peninsula Jylland (Jutland) and the islands. Jylland may tentatively be divided into three natural divisions, Väst-Jylland, Nord-Jylland, and Öst-Jylland distinguished by different soils and different culture and comparing favorably as regards population; but such a subdivision De Geer considers merely experimental. The islands may again be divided into distinct groups—the Eyn group, the Sjaelland group, and Bornholm.

W. ELMER EKBLAW

The Geographical Subdivision of Sweden: A Study in Urban Geography. The proposed subdivision of the Scandinavian countries abstracted above from *Ymer* has provoked further discussion. In the succeeding number of *Ymer* (No. 4, 1918) Dr. Helge Nelson raises the argument that De Geer's standpoint is in reality administrative rather than geographic and that his subdivisions are essentially historical-administrative in character. Dr. Nelson's own proposal is of a more radical nature. His thesis is expounded at greater length in the recent *Festskrift* volume of Lund University (*Lunds Universitets arsskrift*, N.F. Avd. 1, Vol. 14, 1918) in the article "Geografiska studier

over de svenska städernas och stadslika orternas lage," of which a useful summary and review is given by John Frodin in *Geografiska Annaler*, Volume 1, 1919, pp. 400–404.

The primary idea back of the new subdivision is "to define the relationship between man's culture and his environment and to express man's reaction to his habitat and his influence upon his habitat. The basis for such subdivision is to be sought not in the separate natural elements, topography, hydrography, vegetation, etc., nor in an attempted reconciliation of them but in some composite culture factor. The facts of human settlement afford this criterion, more particularly the concentrated grouping—towns and town-like agglomerations. As Jefferson says, "The grouping of these human foci would sketch for us the actual geographic provinces of the earth, not physiographic, not geologic, not climatic, nor yet political, but geographic as showing man on the actual earth in the play of varied forces." In such a view of course the urban unit is considered in relation to the surrounding country. It is regarded as "an organism which has grown out of the landscape to which it belongs as a natural exponent thereof." Furthermore the character of the town is "an expression of different factors which have been at work during the different stages of development."

From this standpoint the author arrives at the subdivision of Sweden into the following geographical regions:

I. The Mountain Region: 65,000 square kilometers with 28,000 inhabitants (0.4 per sq. km.). The single urban center owes its existence to purely local circumstances.

II. The North Swedish Woodland: 138,000 sq. km. with 290,000 inhabitants (2 per sq. km.) of whom 4 per cent live in urban communities.

III. The North Swedish Silurian Region: 13,800 sq. km. with 80,000 inhabitants (5.8 per sq. km.) of whom 17 per cent are urban. The towns are commercial centers. The significance of the calcareous element of the soils of the silurian rocks has frequently been pointed out (see Rabot: La distribution de la population en Suède en fonction de la constitution géologique du sol *La Géographie*, Vol. 11, 1905, pp. 359–367).

IV. The North Swedish Coastal Region: 52,200 sq. km. with 621,000 inhabitants (12 per sq. km.) of whom 19 per cent are urban. There is a line of older towns at the head of river navigation; a group of outposts dependent on the sawmills; a series of industrial and railroad centers.

V. The Gästrikland (South) Dalarne Region: 8,700 sq. km. with 240,000 inhabitants (28 per sq. km.) of whom 40 per cent are urban. The towns are mining and manufacturing centers.

VI. Bergslagen: 8,100 sq. km. with 131,000 inhabitants (15 per sq. km.) of whom 23 per cent are urban.

VII. The Central Swedish Plain and Fault Region: 65,100 sq. km. with 2,506,000 inhabitants (39 per sq. km.) of whom 47 per cent are urban. In subprovince 1, the Mälar country, the ratio of urban (55 per cent) to rural population rises highest. The towns of the eastern coast are typically medieval trading centers at the heads of the bays. On the west they are often fishing centers, while the large lakes have fixed the positions of many towns in this region.

VIII. The South Swedish Uplands: 45,800 sq. km. with 1,060,000 inhabitants (23 per sq. km.) of whom 22 per cent are urban. There are coast towns on good harbors, but no less than 33 of the 45 urban communities are in the interior. Many have come into existence during recent years at points where the railroads intersect old traffic lines.

IX. The Scanian Horst and Plains Region: 9,300 sq. km. with 673,000 inhabitants (72 per sq. km.). Of the population of the Horst only 3.3 per cent is urban. In the southwestern plain the percentage rises to 49; on the Kristianstad plain to 30.

X. The great Baltic Islands, Gottland and Oland. Each possesses one town.

ASIA

Climatic Zones of Japan and Formosa. A zonal classification of the climate of Japan and Formosa is given by Miss E. M. Sanders in the July, 1920, number of the *Monthly Weather Review*. In Japan proper three major climatic zones are recognized based upon the isotherms for January—northern (north of the 32° F. line), central (between 32° and 40° F.), southern (south of 40° F.). The first two zones are susceptible of division each into two types.

In the northern zone the Nemuro type includes the greater part of the island of Hokkaido. It exhibits an extreme temperature anomaly. The average winter temperature is every-

where below 20° F.; the summer temperature ranges between 60° and 70° F. The anomaly is more marked than in the case of Newfoundland with which Hokkaido is commonly compared as regards climate. The rainfall is scanty, less than 20 inches, and is marked by a September maximum (see graph of Abashiri, Fig. 9, p. 27). Southwards temperatures become less extreme and rainfall increases. The Hakodate type includes besides southern and western Hokkaido a part of the main island (see graph of Suttsu, p. 27). The central zone is subdivided into eastern and western types primarily on a basis of seasonal distribution of rainfall. The east has a rainy season in summer, the west in winter. The west is further characterized by greater cloudiness and frequency of fog. As far as the agriculturist is

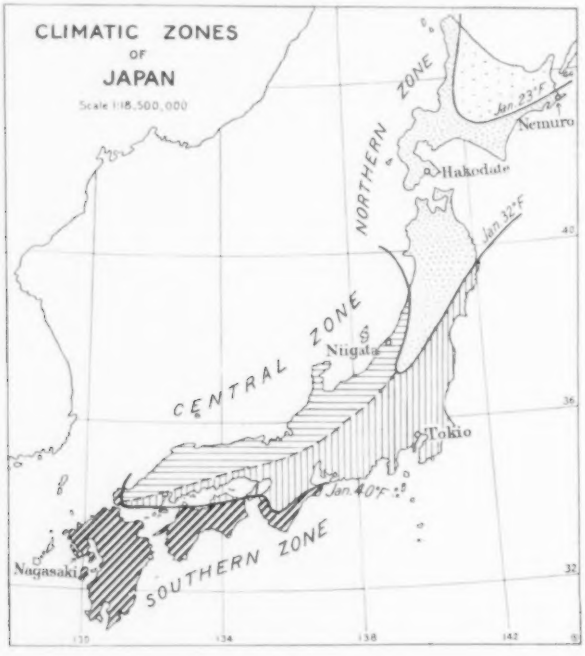

FIG. 1

concerned, the southern part of the central zone is distinguished as a two-crop region—rice in summer and wheat in winter. The southern zone is semitropical, and three crops a year can be raised. The winter temperature is low for the latitude, but the summers with high temperatures and great humidity are enervating.

Formosa on the northern tropic has a typical two-season monsoon climate. The winter monsoon brings heavy rainfall to the north and east of the island. Kashoryo on an eastern hillside has the reputation of being one of the wettest places (289 inches a year) in the Far East. The southwest monsoon brings lighter rains, but the typhoons which prevail during the summer are responsible for abnormal rainfalls.

HISTORY OF GEOGRAPHY AND EXPLORATION

The Farthest Points reached by Bartholomeu Dias. The identification of places visited by early navigators has always raised difficulties. We are familiar in America with discussions about the place where Leif Eriksen built his house in Vinland or as to whether Columbus' first landfall was Watling or Cat or Great Turk or some other island. Of a similarly controversial nature is the problem of the farthest points reached by Bartholomeu Dias on the famous voyage of 1487–1488 during which he discovered the Cape of Good Hope

and about which Canon E. B. Ford has set forth some new theories in a paper recently read before the South African Association for the Advancement of Science (*South African Journ. of Sci.*, March, 1920, pp. 345–364).

The commonly accepted narrative of Dias' voyage is found in De Barros' "Asia," an elaborate and pretentious, though not entirely reliable, work written some sixty years later. From a detailed study of more nearly contemporary sources—particularly certain old maps and the *roteiro*, or diary, kept during the expedition of Vasco da Gama—as well as from an extended personal examination of the ground, Canon Ford has come to the conclusion, among other things, that De Barros was mistaken in saying that the last *padrão*, or stone monument, set up by Dias, was on the island of Santa Cruz in Algoa Bay, although the navigator may well have built a wooden cross at this point. He believes that the *padrão* in question, which was dedicated to San Gregorio, was probably erected at Kwaiihoek, or False Islet, on the mainland to the east. Of greater general interest, however, is the determination of the exact point at which Dias, overcome by the objections of his officers and forced to abandon his ambitious project of pushing on to the Indies, finally put about and headed for home. Canon Ford rejects the long accepted identification of the small river which marked this point, and which was named by Dias "Rio do Infante," with the Great Fish River and favors instead the Keiskama some twenty miles farther east. The latter is at a distance which accords far better with the figure given in the *roteiro* for the stretch between the *padrão* and the Rio do Infante than does the shorter distance between the supposed position of the *padrão* and the Great Fish.

In connection with the date of Dias' voyage, Ravenstein in an article in the *Geographical Journal* for 1900 showed that De Barros was wrong when he placed it in 1486–1487 instead of 1487–1488. As the names given to places along the coast were in many instances taken from the church calendar and bestowed on the days during which the various localities were passed, it is possible for us to gain some idea of the chronology of the voyage from the maps drawn to illustrate it; and, indeed, Canon Ford suggests that "the names given by Dias are well worthy of a more extended study."

PHYSICAL GEOGRAPHY

The Recording of Nighttime Cloudiness. Professor R. DeC. Ward's recent discussion of "Cloudiness in the United States" (*Geogr. Rev.*, Vol. 9, 1920, pp. 347–356), concerns daytime observations of sky cover and duration of sunshine but not nighttime cloud conditions: for practically no records of nighttime cloudiness are available. Eye observations of cloudiness are made hourly at the central office of the U. S. Weather Bureau by watchmen, and irregularly at other Weather Bureau stations. Some astronomical observatories also keep records of night cloudiness. The only automatic records of night cloudiness made in the United States are taken at Blue Hill Observatory (Harvard University) and at the University of Chicago station of the U. S. Weather Bureau. The instruments used are modified Pickering Pole-Star (photographic) recorders. The apparatus at Chicago was only recently installed (described in *Monthly Weather Rev.*, Mar., 1919, Vol. 47, pp. 154–156). A similar night cloudiness recorder has recently been brought into use at the Royal Observatory, Greenwich (described and discussed in *Quart. Journ. Royal Meteorol. Soc., July, 1920*, Vol. 46, 1920, pp. 243–244). In view of the blanketing effect of clouds on nocturnal cooling, night cloudiness is worthy of close observation, especially where there are fruits or other crops subject to frost damage.

CHARLES F. BROOKS

GEOGRAPHICAL REVIEWS

The Development of Argentina

Pierre Denis. **La république Argentine: La mise en valeur du pays.** 299 pp., maps, bibliogr. Armand Colin, Paris, 1920. 14 fr. 9 x 5½ inches.

Scholarly geographical works on South America are few, and the appearance of a volume on the Argentine by the author of "Brazil" in the South American Series will be welcomed by serious students of geography the world over.

The volume is not a systematic regional geography. In his introduction the author points out that such a treatment, while it is the most satisfactory for the long-settled countries of Europe, is not necessarily the best for the Argentine, where one of the salient elements in the geography is still the constant shifting of the population and the transitory nature in any one region of a special type of exploitation. If geographers will accept this and study the work from the viewpoint of the author they will find it fit to take its place beside the best regional studies of Europe. The book has as its subtitle "La mise en valeur du pays," and it partakes in part of the nature of an examination of the economic life of the country and is at the same time an explanatory history of colonization in the Argentine. But, inasmuch as the author is a geographer, there is scarcely a page of the work which does not set forth some leading feature of the varying physical environments which lead to such a variety of economic conditions.

The author's book on Brazil was written for the general and non-technical reader, and yet it contains a most valuable sketch of the geography of that country. The present work is evidently intended for a different public. It presumes a considerable knowledge of the processes and conditions underlying the physical geography. A brief explanatory statement of the physical geography as an introduction might however have been added with advantage.

The work begins with a short chapter on the natural regions and sets forth the leading features of the landscape in each. The close relationship between the details of surface relief and soil on the one hand and climate on the other are well brought out. In this chapter we are introduced to the human responses to these environments throughout the history of the country.

The next two chapters deal respectively with "The Oases of the Northwest and the Pastoral Life in the Scrublands" and "Tucumán and Mendoza, the Great Industrial Cultures." In these two as in subsequent chapters the historical development of local industries and occupations is traced in considerable detail; and the accounts of the actual state of industries throughout the book appear to be so well informed, both as regards technique and labor conditions, that each might have been written by an expert. In these chapters we learn of the three zones of habitation in the northern Cordilleras—the wide *valles*, the narrow *quebradas*, and the *puna*. The account of water resources and of the elaborate and ancient customs regarding their utilization merits careful study. The same is true of the description of the great sugar industry of Tucuman and the anomalous climatic conditions which have made it possible, while the response of the wine industry of Mendoza to physical geography is clearly set forth.

Chapter 4 is entitled "The Exploitation of the Forests, but it includes other aspects of the geography of the two main forest regions—the Chaco with the Paraná valley and the narrow slice of the typically Brazilian forest included in the territory of Misiones. The omission of the southern Andean forests is explained by the statement in the chapter on Patagonia that the chief economic use of these is in the regulation of run-off in connection with the hydraulic schemes of the future. Since the lumbermen of the Chaco forests are largely drawn from the irrigation oases of the *bañados*, further west, the author characteristically opens with a description of the life in these oases, with the emigration in May to Tucumán for sugar work, in October to Córdoba and Santa Fé for agriculture, and throughout the year to the Chaco forest. An interesting contrast is drawn between lumbering, on the one hand, in the interior of the Chaco with its small mobile mills owned by men of small capital and incapable of being worked economically very far from the railways and, on the

other hand, the forest operations near the Paraná carried on entirely by the great tannic acid combines possessed of large capital and owning great factories. The latter draw their labor from the left bank of the river and use the quebracho wood almost entirely for the extraction of the tannin. In this belt the land tends to get into the hands of a smaller number of owners each year, and in the province of Santa Fé the entire forest is divided between two companies. The author expects that the Chaco forest will eventually disappear and give place to cattle ranches.

Of Misiones with its forest life we have a brief but satisfactory picture: the lumbering in the Araucaria woods; the *maté* industry, with its serflike labor, which may be compared to the rubber gathering of the Amazons; and the small agricultural settlements in the clearings.

Chapters 5 and 6, on Patagonia and the Pampas respectively, are perhaps the most satisfactory part of the book from a geographical standpoint. They are much more systematic in their treatment and are so rich in content that they should be carefully read by all geographers. The physical conditions are never lost sight of. In each region they are sufficiently well-known to permit of a subdivision into what are probably the real human geographical provinces, each with its distinct and fairly well-established mode of life. The Pampas chapter is a specially good example of a study of this kind.

Chapter 7 describes the main roads and railways in the Republic, sketching their setting, their development, and the economic basis of their traffic; while Chapter 8 deals with the waterways in similar fashion. In the latter chapter is included a physical description of the Paraná and Uruguay systems which is lucid and thorough. The work concludes with a chapter on the population, its distribution and its movements, the sites and character of the cities, leading up to a sketch of the personality of Buenos Aires.

As we may hope that the work will speedily run into a new edition, it may be useful to point out a fault which can be easily remedied. The maps, seven in number, are insufficient. They were doubtless limited by the cost, but the publisher would be well advised to allow more scope in this matter. To take but two instances: the detailed description of the Paraná, with its changing meanders, and the account of the contours in the pampas are greatly impaired by complete lack of illustration. But the existing maps would be doubly useful if placed at the end of the book so as to fold out, and if references to them were given in the text. There is not a line on these diagrams that is not essential. The work contains an exceedingly useful bibliography with critical annotations.

The British West Indies in Relation to the American Revolution

F. W. Pitman. **The Development of the British West Indies, 1700–1763.** xiv and 495 pp.; map, diagrs., bibliogr., index. (Yale Historical Publications: Studies, IV.) Yale University Press, New Haven, 1917. $2.50. 8½ x 6 inches.

As in most modern wars, economic causes lay back of the American Revolution. Questions of trade were almost as important a factor in bringing about that conflict as were political rights and liberties. The present volume, in addition to treating of the development of social life, the distribution of land holdings, the labor problems encountered, and the financial systems in vogue in the West Indies, presents a carefully detailed account of some of the economic conditions which contributed to the separation of the North American colonies from Great Britain. The work is based chiefly upon manuscripts found in the British Museum and the Public Record Office.

The exchange of commodities between North America and the West Indies Islands figured prominently among these economic factors. These two regions were geographically complementary. In climate and soil, hence in their products, they were sharply contrasted. The typical productions of New England, such as grain, lumber, fish, and horses, together with the limited output of incipient Yankee manufacture, barrel staves, hoops, boards, and shingles, found their nearest and most natural market in the tropical colonies that stretched from the Bermudas to Surinam, while the rapidly growing settlements along the North Atlantic coast offered a ready emporium for a large part of the sugar which was almost the sole product of the West Indies. But this trade, based on geographical dissimilarity of the two regions, refused entirely to recognize the artificial boundaries established by political sovereignty. Such a condition was not at all in keeping with the commercial policies prevailing in Europe; hence England and France, the mother countries most

directly concerned, attempted to restrict colonial trade within the bounds of their own possessions. Here geographical laws of trade clashed with those of political legislation. The latter were largely ignored, and illicit commerce flourished, in spite of attempted enforcement of restrictive measures. None of the legislation, culminating in the "Molasses Act" of 1733, all of which aimed to prevent trade between British colonies and foreign markets, was able to divert commerce from these natural channels which ruthlessly crossed political boundaries.

So strong were these geographical laws of trade that, in spite of all legislation to the contrary, commercial relations between these climatically complementary regions became too deeply entrenched to yield even in times of war. During the Seven Years' War, when the two European powers were in conflict, and even when the conflagration extended to their respective New World possessions, the colonies continued to exchange their wares. Civil and naval measures were alike fruitless. In fact the British colonists, though their royal governors sought to check this trade, were, as a people, thoroughly convinced that their interests lay in maintaining direct commercial relations with their West Indian clients of whatever nationality they might be. Thus entered the wedge which rapidly brought about a complete rupture between the people of the thirteen colonies and the government of the mother country.

Since the one product of the West Indies was sugar (with its by-products of molasses and rum), this history reveals, too, how important a rôle was played by a single commodity in the political relations of the British Empire at that time. Just as cotton, coal, iron, and petroleum have, time and time again, exerted a controlling influence in world politics, so sugar, as an item of international trade, was one of the important factors leading up to the separation of the colonies from England.

The Forest Resources of British Columbia

H. N. Whitford and R. D. Craig. **Forests of British Columbia.** viii and 409 pp.; maps, ills., index. Commission of Conservation, Canada. Ottawa, 1918. 10 x 6½ inches.

The province of British Columbia comprises about 355,000 square miles of territory and contains some of the most magnificent coniferous forests in the world. Owing to differences in topography and climate, however, the vegetation varies greatly—from almost luxuriant forest in the southern coastal region to semi-arid cactus and sagebrush growth on the interior plateaus—and there are approximately 200,000 square miles of country which are incapable of producing forests of commercial value.

British Columbia has been described as a "sea of mountains," and it has been estimated that the average elevation of the land surface for the province is over 3,500 feet. Considered from a physiographic standpoint three great montane regions or "belts," roughly paralleling the seacoast, are to be distinguished: the Western, Central, and Eastern Belts. Each of these belts is further subdivided into two or more mountain or plateau systems, and these, in turn, into specific ranges, groups, or plateaus. The Western Belt comprises (*a*) the Insular System, embracing the mountains on the islands adjoining the mainland; and (*b*) the Pacific System, embracing the Cascade Mountains (a small area lying east of the Fraser River) and the Coast Mountains (including the Bulkley Mountains), together with certain unnamed mountains, on the mainland. The Central Belt comprises (*a*) the Interior System, embracing the Fraser and Nechako plateaus and certain unnamed mountains and plateaus; (*b*) the Cassiar System, embracing the Stikine and Babine Mountains and certain unnamed mountains; and (*c*) the southern portion of the Yukon System, embracing the Yukon Mountains and various unnamed mountains and plateaus. The Eastern Belt comprises (*a*) the Rockies System, here being composed of the Rocky Mountains, and (*b*) the Columbia System, embracing the Selkirk, Monashee, and Cariboo Mountains. In addition to these various montane regions and systems, there are distinguished four great intermontane valleys or trenches: (*a*) the Coastal Trench, lying between the Insular System and the Pacific System; (*b*) the Selkirk Trench, separating the Monashee from the Selkirk Mountains; (*c*) the Purcell Trench, cutting lengthwise through the Selkirk Mountains; and (*d*) the Rocky Mountain Trench, separating the Eastern Belt from the Central. These various physiographic features, discussed in some detail, are clearly brought out on an accompanying map (for the southern portion of the province compare R. A. Daly's map accompanying

"The Nomenclature of the North American Cordillera between the 47th and 53rd Parallels of Latitude," *Geogr. Journ.*, Vol. 27, 1906, p. 588).

Correlated in a general way with the orographic features of the country, and even more important in their relation to the character and distribution of its forests, are a series of climatic belts: (*a*) the Coastal Belt, comprising the coastal islands and mainland and the western slopes of the Coast Mountains; (*b*) the Dry Belt, embracing the eastern slopes of the Coast Mountains and most of the region elsewhere designated as the Central (physiographic) Belt; (*c*) the Interior Wet Belt, centering in the region occupied by the Monashee and Cariboo Mountains; (*d*) the Rocky Mountain Belt, embracing primarily the western slopes of the Rockies; and (*e*) the Great Plains Belt, east of the Rockies. The Coastal Belt is characterized by high precipitation and by comparatively mild temperatures throughout the year; elsewhere, except in the interior wet belt where the precipitation in general is moderate, the climate is relatively dry with pronounced seasonal fluctuations in temperature. Owing mainly to differences in latitude and altitude, however, there are considerable variations in precipitation and temperature within these climatic belts.

The forests of the province are grouped into two divisions: Coastal and Interior. In the Coastal region, five different climatic types are distinguished, in the Interior about fifteen. The nature and composition of each type is briefly discussed, together with its climatic and soil relations, areal distribution, and various economic considerations. Numerous colored maps graphically depict the geographic distribution, not only of these various forest types, but also of the more important forest trees, to which a separate chapter is devoted.

GEORGE E. NICHOLS

ROMAN ROADS IN BRITAIN

THOMAS CODRINGTON. **Roman Roads in Britain.** 3rd edit. ix and 317 pp.; maps, index. Society for Promoting Christian Knowledge, London, 1918. 10 s. 8 x 5½ inches.

This book is a monument of devotion to detail, assiduity in investigation, and a firm grasp on all phases of the subject, making it a nearly exhaustive disclosure. Every authentic source of information has been drawn upon—Latin works contemporary with the Roman occupation, medieval authors, a copious array of the topographical or incidentally descriptive works of the more recent centuries, the multitudinous widely scattered reports of local investigation, and the testimony of the soil and surface at the present day—often, apparently, as interrogated by Mr. Codrington in person.

Its importance to history and political geography need not be enlarged upon. Perhaps the Saxons preferred the open country after they had settled down, using the Roman roads chiefly to mark boundaries, but the course of invasion must have been largely affected by these easy avenues of ingress, and the sites of battlefields must have been determined in some instances by their river crossings or the points where they penetrated or skirted rough defensible country. But even during the preceding three and a half centuries of imperial rule, at last merely nominal, the movements of the legionaries as well as every shifting of the native population and its commerce, with much beside, must have recorded itself in the opening of new roads, the extension or partial disuse of old ones, and their modifications in various ways.

Where so much has been given, it seems rapacious to call for more; but a series of maps showing these roads as they existed at stated intervals, say at the ends of the first, second, third, and fourth centuries, would be very welcome for purposes of comparison. The concluding chapter partly supplies this need, however, by its speculations as to the dates and order of road-making for the various highways, and the general map appended displays the entire system as now indicated without reference to time of origin or disuse. Perhaps no more could be done; and certainly it is a great deal.

The coins found far in the outskirts of the island indicate that the more important roads were put through early in the period of occupation. Some of them certainly lasted until long after it, as available means of communication and travel. The Laws of Edward the Confessor recite four of these great roads, Ermine Street, Watling Street, Icknield Street, and Fosse Way, as especially under the king's peace, and relate that two of them ran lengthwise of the kingdom, two across. Three of these were recognized in the reign of William the Conqueror. Ermine was the great northern road which ran from London to Lincoln and thence on to North Britain; Watling Street ran northwestward from Dover

and neighboring ports through London and the heart of the country to Wroxeter (Uriconium) and North Wales; Icknield Street ran southwest from the country of the Iceni eastward of Cambridge to Devon, connecting with Fosse Way not very far from Exeter. Fosse Way held a general course east of north from Exeter through Bath and Leicester to Lincoln. Watling Street crosses two of these other main roads; Fosse Way crosses two and joins two. Another great and ancient way was Riknild Street, which ran nearly north and south, branching from Fosse Way opposite Gloucester and approaching Ermine Street near Leeds at the great bend of the latter road to avoid the marsh country on the east. The list of important roads might easily be extended. With their branches, the general effect is to turn the map of Britain into the likeness of a dislocated checkerboard. But apparently through all changes some areas of unconquerable wilderness remained. The greatest of these was south of London, mainly occupied by the Andred wood and crossed only at one or two points in the whole stretch between Canterbury and Winchester. The western part of the Damnonian peninsula and a large expanse in Wales are also blank of Roman roads. But the greater part of the island was exceedingly well supplied with them, and their construction, though variable in different regions and at different times, was generally durable and workmanlike, employing materials which later occupants of the land found an advantage in stripping off freely for their own use.

W. H. Babcock

The Blue Guides Versus Baedeker

Findlay Muirhead, edit. **England.** lxxii and 598 pp.; maps, diagrs., index. (Series: The Blue Guides.) Macmillan & Co., Ltd., London; Librairie Hachette & Cie, Paris, 1920. $5.50. 7 x 4½ inches.

Karl Baedeker. **Great Britain.** Written by J. F. Muirhead. 7th edit., revised and augmented. lxviii and 624 pp.; maps, diagrs., index. Karl Baedeker, Leipzig; T. Fisher Unwin, London; Charles Scribner's Sons, New York, 1910. $3.00. 6½ x 4½ inches.

Here is a peculiar situation—a man with a decided penchant for making a good guidebook has for many years taken a very active part in the preparation of the English editions of Baedeker's Handbooks and wrote the one on Great Britain. In time the great World War develops, and Karl Baedeker is found to hold a very large brief for the Imperial General Staff (see "Baedeker as an Officer of Military Intelligence," *Scientific American*, November 2, 1918, p. 354), while innocently taking in marks, francs, shillings, and dollars for the alluring red-bound books with their comb-marbled edges and the little prayer, "Go, little book, God send thee good passage," etc., on the reverse of title page. What a position for an author! How could he see his life work rendered impossible for English-speaking visitors, for it will be many years before Baedeker's guides will come into the vogue they enjoyed before 1914, if they ever do.

It is interesting to compare the two guidebooks and see whether the recently produced work is an improvement. In the main the verdict is favorable.

The "Practical Information" is excellent, as might be expected from Mr. Muirhead's experience. The constantly changing post-war conditions render this section particularly valuable, and it is severely up-to-date, for we find a chapter on "Aviation in England" and routes and rates for the air services to the Continent.

An "Introduction to the Study of English Monuments," by Professor G. Baldwin Brown (p. xiii), replaces the "Historical Sketch of Architecture in England," by the late Professor Edward A. Freeman in the Baedeker.

The Routes are excellent and are along the same general line as in the Baedeker, for there is really no other way out. The Blue Guide, however, does not embrace Wales or North Britain, which we used to call Scotland. This is of course a limitation which will be sorely felt by the tourist who has but a few days for North Wales or the Trossachs. The book is big enough already, but it is to be hoped the remainder of Great Britain will be provided for by a supplementary volume of small bulk and issued at a low cost.

It must be admitted that the German cartographers have made maps which in some cases are superior to those of the Edinburgh print of the Blue Guides. The plan of Hereford is certainly clearer in the Blue Guide; but the territory embraced in the plan is hardly wide enough for the use of the tourist. The plan of Oxford again makes the mistake of magnifying

the center of the town while several important buildings and other objects of interest are omitted. The maps of the Wye Valley are, with the exception of coloring, almost identical. The reviewer tabulated 55 maps and plans in the two books and after weighing all the points decided in favor of the Blue Guide in 31 cases and Baedeker in 25 cases. There are 12 plans in Baedeker that are not contained in the Blue Guide: Rochester, Hastings, Torquay, Northampton, Coventry, Leicester, Derby, Carlisle, Leeds, Bradford, Newcastle, and Scarborough.

The verdict is, if you can have both books in your library, do so; but, if you can have but one, take the Blue Guide. This will probably permanently displace Baedeker as regards England. As for London, there is also an excellent guide to that city in the new series.

A. A. HOPKINS

HISTORICAL GEOGRAPHY OF THE ITALIAN FRONTIERS ABOUT THE ADRIATIC

ATTILIO TAMARO. **La Vénétie Julienne et la Dalmatie: Histoire de la nation italienne sur ses frontières orientales.** Vol. 1, **La Vénétie Julienne**, xii and 1033 pp.; map, bibliogr.; Vol. 2, **La Dalmatie (depuis les origines jusqu'à la Renaissance)**, xi and 501 pp.; map; Vol. 3, **La Dalmatie (depuis la Renaissance jusqu'à la guerre européenne)**, xii and 688 pp.; bibliogr. La Società Nazionale "Dante Alighieri," Rome, 1918, 1919. 10 x 6½ inches.

This is the most comprehensive synthetic treatment of the subject known to the reviewer. It is the product of extensive and prolonged study, but it was written in great haste under adverse conditions. The value of the contents is consequently variable. Some topics are given greater space than their importance in relation to the subject seems to warrant, while others are dismissed summarily. A chapter here is based upon important sources difficult of access, while a chapter there contains significant statements supported only by secondary authorities, when the original sources were available. The style is prolix. These inequalities detract somewhat from the value of the large mass of material supplied by the diligence of the author's research. A more serious defect is the writer's prejudice, which has affected both his selection of evidence and his interpretation of it. Tamaro practically acknowledges that the work is in part an attempt to justify the Italian claims to territory on the northern and eastern shores of the Adriatic (Vol. 3, pp. 687, 688). This impresses the reviewer as the principal object of the book. Yet it is not to be dismissed merely as a gigantic piece of propaganda, for it adds much to our knowledge. To the reader who is unfamiliar with the subject it offers a poor avenue for the first approach, but the reader who has a sufficient acquaintance with the subject, or with the principles of historical criticism, can separate the wheat from the chaff, for Tamaro cites his authorities scrupulously.

Geography occupies a considerable place in this primarily historical work. Several chapters are given to descriptive geography, and the historical narrative is often woven about questions of boundaries.

Julian Venetia is a name used by Italians to designate a district north and east of the head of the Adriatic. As no political division appears ever to have borne the title, each writer is left free to assign to Julian Venetia such limits as he sees fit. Tamaro defines it as "bounded by the Alps up to the Fiumara east of Fiume" (Vol. 1, p. 1). This definition is vague. Tamaro therefore proceeds to a more detailed consideration, after giving a brief description of the principal geographical characteristics of the region. He assumes that the boundary of Julian Venetia coincides with the "sacred frontiers" which Nature gave to Italy on the northeast. These are established by the summits of the mountains which divide the waters flowing into the Black Sea from those flowing into the Adriatic. Tamaro's attempt to locate the line of crests, however, leaves one with the impression that Nature did her work in a slovenly fashion. From the Predil pass to the headwaters of the Idria the course of the watershed is clear enough, but south of Idria the Piuca and the Uncia Rivers follow the custom of the Carso and disappear in the earth. Some geographers maintain that the Piuca runs into the Uncia and the Uncia into the Save, but Tamaro holds that this view has not been sufficiently well proved by scientific experiments to exclude the possibility that these rivers drain into the Adriatic. Tamaro discusses the views of several German and Italian geographers, making evident the inability of Italian scientists to agree among themselves as to the course of the sacred frontier in this region. He finally accepts the hypothesis of Porena that the boundary goes southward from the headwaters of the

Idria to Mt. Nevoso (Schneeberg) by way of the Birnbaumer Wald (Selva del Pero) and Mts. Strana, Javornig, and Toro, dividing the basin of the Piuca from that of the Uncia. Thence he draws the line down the mountains to the source of the Fiumara and along the left bank of that stream to the sea. Irredentists of the sixties, like Bonfiglio, who recognized the Arsa as the proper frontier are dismissed as ignorant political opportunists.

The history of the northeastern boundary is scattered here and there throughout the remainder of the first volume. Tamaro's thesis seems to be that the boundary of Italy since Roman times has generally extended as far to the east, either in fact or in national consciousness, as he places it. He has accumulated a vast store of evidence, but his interpretation of it is not always to be trusted. In a summary of the views of those authorities who hold that the Julian Alps constitute the natural frontier of Italy he speaks of "the historian of the invasions of Italy, Hodgkins (*sic*), who has marked the frontier passed and violated by them at the great Alpine wall which encloses Julian Venetia" (p. 33). The only reference to the Alpine wall at the place indicated in Hodgkin's work is a note which reads: "Is the fury of the Bora owing to the abrupt termination here [*i. e.* Tarnovaner Wald] of the great Alpine Wall . . .?" Hodgkin gives no indication that he regards the Alpine wall as the boundary of Italy or of Julian Venetia. The conclusions that Tamaro draws from his evidence, moreover, appear in some instances to be unjustified. He, for example, places Laibach within Italy in the fourth century (p. 95). The anonymous author of Bordeaux, whom he cites, corroborates this statement; but Herodien, whom he also cites, says nothing about Laibach at the place specified. From this evidence, furthermore, it does not necessarily follow, as Tamaro asserts, that the political frontier of Italy had been extended beyond the Arsa, where it was located in the first century. His supposition that Fiume (Tarsatica) was then part of Italy is, as he admits, based upon no direct evidence. Concerning Dante's famous lines,

". . . Pola presso del Quarnaro
Che Italia chiude e i suoi termini bagna,"

he tells us (p. 359): "The designation of Dante cannot be taken in a narrow sense, as if the poet intended to limit the Italian frontier to the Arsa. He meant, on the contrary, to include in it all the eastern coast of Istria up to the head of the gulf of Quarnero." But he does not explain how he knows what Dante meant. In another instance he draws a conclusion that does not seem to be warranted by his own interpretation of the evidence. He says (p. 354) of Riccobaldo of Ferrara, who wrote a geographical description between 1280 and 1300: "It is interesting to note that he places the frontier of Istria in the Liburnian gulf, therefore beyond the Arsa and manifestly in the angle where the Fiumara, the ancient Tarsia, disembogues." It seems far from manifest that the general statement of Riccobaldo refers specifically to the one spot in the Quarnero selected by Tamaro. Instances of these sorts are sufficiently frequent to make it advisable to refer to the authorities whom Tamaro cites before accepting unreservedly his statements with regard to the history of the northeastern boundary. His work on this aspect of the subject, nevertheless, is not without value, because he has brought together references to a vastly larger number of sources than are to be found in any other single work.

The volumes on Dalmatia begin with five chapters of descriptive geography where the view is advanced that Dalmatia does not belong to the Balkan Peninsula but forms part of Italy geologically, orographically, biologically, and anthropogeographically. In subsequent chapters there is little of geographical interest. The opinions of contemporaries who at various epochs looked upon Dalmatia as geographically a part of Italy are adduced occasionally, and the history of the Dalmatian boundaries also receives some notice but is treated as a topic of slight importance.

W. E. Lunt

Primitive Peoples of Cochin-China

Henry Baudesson. **Indo-China and Its Primitive People.** Transl. by E. A. Holt. xii and 328 pp.; ills., bibliogr. E. P. Dutton & Co., New York, [1919]. $5.00. 8½ x 5½ inches.

A scholarly treatment of the Moï and the Cham, two distinct peoples living in the mountains of Cochin China a hundred miles or so west of the China Sea. Their country is, politically, a French protectorate. While primitive peoples, they have made some advance-

ment, and Captain Baudesson calls them "half civilized." The Moï have a legend that Mother Eve told those of her sons who were jolly fellows and fond of good living to settle on the fertile plains; but to one of her sons, a quiet and sober lad, she gave a bow and arrows and the kingdom of the mountains where the wild beasts roam. He was the ancestor of the Moï, who, the author says, may number nearly 400,000.

The Cham, on the other hand, supposed to number about 130,000 souls, have approached a little nearer to what we call civilization. They are Mohammedans and have preserved their physical and moral characteristics largely because they do not intermarry with other peoples. But retrogression is in progress. They are indolent, have no ambition, hire the Annamites to build their rude houses, and, at the same time, are proud of the ruins of splendid edifices erected long ago by their forefathers. The author also points to striking resemblances between customs and superstitions among the blacks of central Africa and the lower classes among these Asian peoples.

CYRUS C. ADAMS

MORPHOLOGY OF THE ALTAI MOUNTAINS

J. G. GRANÖ. **Les formes du relief dans l'Altaï russe et leur genèse: étude morphologique.** Maps, ills., bibliogr. *Fennia*, Vol. 40, No. 2, pp. 1-125. Helsingfors, 1917-19.

No more striking example of the explanatory treatment of mountain forms has appeared in recent years than the above article by the Finnish geographer, Granö, of the University of Helsingfors. The northwestern or Russian part of the Altai Mountains between the upper courses of the Obi and Irtysh Rivers—an area measuring 400 kilometers northeastward by 350 northwestward—is described as consisting of an uplifted and dislocated peneplain in a more or less advanced stage of erosion, the peneplain having been produced over a vast area by long-continued normal erosion of greatly deformed structures, and its undisturbed extension being still seen in the piedmont steppes to the northwest. The least dissected part of the uplifted peneplain forms a series of barren, tundra-like highlands, which occupy the greater part of the southeastern half of the region at altitudes of from 2,000 to 2,300 meters. The small amount of dissection that the highland peneplain has suffered, apart from the deep valleys which traverse it, is because its altitude is such that during the glacial period it was covered for the most part by a sluggish ice sheet and thus protected from active erosion. The highlands are surmounted by mountains of various kinds. Some are of subdued forms, apparently residual ranges still surviving from the cycle of peneplanation (these presumably follow the trend of resistant structures); the smaller isolated residuals are dulled monadnocks. But there are also lofty ranges of Alpine form, from 50 to 100 kilometers or more in length and from 2,400 to 4,000 meters in altitude, with extensive snow fields on their upper slopes and good-sized glaciers in their valleys; these ranges usually trend east and west, out of accord with the folded structure of the region, and are regarded as blocks of the peneplain which were dislocated by faulting and raised so high that they have been strongly carved by normal and glacial erosion. Some of the less elevated ranges still exhibit remnants of the peneplain surface along their crests; others have all their sharpened summits at about the same level; but in the most lofty ranges no trace of the peneplain remains. The frontier between Russian and Chinese territory follows several of the lofty ranges which here constitute the divide between Arctic and interior river systems.

Almost half of the region lies exterior to the barren highlands at altitudes decreasing northwestward from 2,000 to 500 meters; here, although the uplifted peneplain is preserved along certain divides, it is for the most part maturely dissected by normal erosion to mountainous or submountainous forms, which are richly grass-covered on certain southern slopes, but generally forested. The piedmont peneplain has a width of from 40 to 70 kilometers; its gently undulating, treeless surface, here and there rising in low and somewhat craggy mounts, is almost intact at altitudes of 300 or 400 meters, but the larger rivers have recently incised their courses moderately beneath its surface. Farther northwest the vast Siberian plains are covered with sand and clay deposits.

The valleys of the Altai in the forested mountainous or sub-mountainous area are usually V-shaped and so narrow-floored that they do not serve well as paths of travel. But the upper valleys of the larger rivers and their chief branches which head in the Alpine region and continue through the highlands appear to have been followed by active glaciers,

as they now have the form of glacially overdeepened troughs. The greater troughs extend into the maturely dissected area, where they terminate at altitudes of about 400 meters. The earlier view of certain observers that the trough valleys are due to faulting is examined and rejected. Their open floors are more available for travel than the narrow bottoms of the V-shaped valleys, and they serve here and there as sites for the winter villages of the nomadic natives, when the highlands are snow-covered. Certain branch valleys are broadly floored with alluvial deposits, as if they had held temporary lakes while their trunk valleys were occupied by glaciers. On the other hand, several rather extensive intermont basins, occupied by smoothly aggraded alluvial plains, are ascribed to down-faulting and thus are the opposites of the strongly elevated blocks in the lofty ranges.

This valuable article, of which the preceding paragraphs give only a condensed abstract, calls for several comments. It is in the first place pre-eminently intelligible. The landscapes that it describes in outline can be at once visualized with satisfactory definiteness as to their essential qualities. The general concepts thus gained are then elaborated and given quantitative values in order to adapt them to specific instances. This intelligibility, to which the explanatory terminology so largely contributes, is however somewhat obscured by an argumentative manner of presentation on many pages. This manner appears to have been adopted because of the author's well-grounded wish to modify, if not to combat, the conclusions of a number of earlier explorers, some of whom seem to have been little informed as to modern physiographic principles. Such argumentative presentation is a natural characteristic of the developmental stage of an advancing science, when opinions are in a formative state. A more concise form of explanatory presentation will be generally utilized when the majority of explorers reach essential agreement as to the manner of describing land forms; indeed, such conciseness is already adopted by Granö in certain summaries near the close of his article. Had these summaries been placed at the beginning, his readers might have had the enjoyment of following the author's descriptions and discussions while bearing his well-formed conclusions in mind; for, however cautiously and inductively an observer may wish to establish his conclusions, mature and expert readers will be best satisfied if they are told the main conclusions before they read the evidence that leads to them. Geometers have long known and acted on this principle; geographers might profitably adopt it.

A subordinate difficulty in reading the text is the free use of local names, which, although most of them are represented on an outline map, are mentioned without sufficient indication of their position in the region under discussion. Where the matter is so excellent, one must wish that the method should be of a correspondingly high order.

It is only in regard to forms of a special class that the treatment is defective, these are the fault scarps by which the lofty ranges are believed to be limited. In a region that has been recently and rapidly elevated and dislocated, and in which the highest ranges are defined by faults, fault scarps, even though for the most part destroyed by erosion, might still be visible in series of spur-end facets which should stand in simple alignment independent of structure along the base of the ranges. True, one range according to the description of another observer, is said to "rise like a wall"; but mountain-side walls are so battered and breached that fuller description is desirable; and in the case of fault-block ranges observed by Granö himself fuller description might have been advantageously given. This is a small deficiency of an exceptionally valuable essay.

W. M. Davis

A Seaman in the Antarctic

J. K. Davis. **With the "Aurora" in the Antarctic, 1911-1914.** xxii and 183 pp.; maps, diagrs., ills., index. Andrew Melrose, London, [1920]. 18 s. 9½ x 7 inches.

Three different methods of exploration have been employed to wrest her secrets from the icebound southern continent. Two of these, dealing with the polar plateau and with land journeys along the coast, have been described in many well-known books. It has remained for Captain John King Davis to tell us of the third in his recent book "With the *Aurora* in the Antarctic."

Here we find the story of his unrivaled oceanographic work in the waters between Australia and Antarctica during the Australasian expedition of 1911–1914. Although in other expeditions valuable results were gained by the exploring vessels during their cruises in

the winter months, none of these equals the work done by the *Aurora*, and none of the masters has hitherto given us more than a summary of his investigations.

An early chapter deals with Macquarie Island, that queer ridge of glaciated rock which may be described as a tile set on edge athwart the wild west winds. All round this dependency of the Commonwealth the *Aurora* made soundings which revealed the profundity of the depths surrounding it. Then we are told of the mysterious Royal Company Isles which were "discovered" in 1776 by a Spanish captain about 400 miles south of Tasmania. Unfortunately for the Spaniard, Davis sailed right across the alleged position of these islands, which must now disappear from the charts. Another interesting chapter deals with the Auckland Isles to the south of New Zealand. We should have liked more particulars of the castaways and settlements which have enlivened the history of these desolate subantarctic islands.

In November, 1912, Davis was dredging 250 miles south of Tasmania when his apparatus was carried away by what may best be described as a crag of a "drowned Tasmania." Rising 8,000 feet above the ocean floor he found a large plateau, "Mill Rise," which raises interesting questions as to a former connection between Australia and Antarctica.

The most vital chapters in the book deal with his hazardous voyages along the icebound coast of Antarctica. The reviewer has spent many months sledging in the Antarctic and has had some slight experience of aviation, but for supreme danger and discomfort he places easily first a cruise among the bergs in the twilight of a polar autumn. Yet this was a commonplace to Captain Davis—the most experienced navigator of Antarctic waters. We read much of the treachery of the famous blizzards. For instance, while waiting to take off Mawson's party at the main base, the *Aurora* was anchored a short distance from the shore. The boats had just taken advantage of a period of calm to land some stores. Suddenly a single terrific gust struck the ship, snapped the anchor chain, and blew the *Aurora* far to the north.

A typical account of the weather describes the day when Mawson was successfully picked up. "At 8 A. M. the land became invisible owing to the driving spray and drift. At 10 A. M. the wind averaged about 70 miles an hour, with squalls of terrific violence. At 11 it reached the strength of a hurricane, the sea was cut off almost flat by the force of the wind. The glass has fallen three-tenths of an inch." We are not surprised that the *Aurora* broke two anchors and lost three others in these tempestuous seas.

Later chapters describe the variations in the ice pack off Antarctica. It is most interesting to know that 1914 was marked by an unusually wide and unbroken belt of pack ice. Is it not possible that this greatly affected the temperature of Australian waters and was a vital factor in determining the great drought of that year? In this section the book is specially well illustrated with sketch maps.

Davis is generous in his praise of the French and American expeditions of 1840. There is a full appreciation of the heroic struggles of Lieutenant Wilkes, Davis following stage by stage the gallant voyages of the sailing ship *Vincennes* in these perilous seas. A series of comparative charts show that the old sailing vessel has rarely been beaten even in these days of steam. We learn that Côte Clairie of the French turns out to have been merely Ice Barrier, for the *Aurora* sailed nearly 100 miles south of this. Here she discovered a new land to which the Australians gave the name of Wilkes Land.

In the last chapter Davis sounds a note of warning: "To the explorer who has not the money to provide good equipment of every kind, my advice is—keep out of the Antarctic!"

GRIFFITH TAYLOR

A TEXTBOOK OF METEOROLOGICAL PHYSICS

W. J. HUMPHREYS. **Physics of the Air.** xi and 665 pp.; maps, diagrs., ills., index. The Franklin Inst. of the State of Pennsylvania. J. B. Lippincott Co., Philadelphia, 1920. $5.00. 9½ x 6½ inches.

The foremost aerographer of Europe in the preface to his "Manual of Meteorology" (1919) said,

"The physical and dynamical principles upon which the processes of weather depend are the common property of all students of physics. If those to whose care the progress of physics is entrusted had taken the physical problems of the atmosphere under their charge as their predecessors did before the advent of the electrical era, one-half at least of this book might have been more effectively dealt with by other hands."

"Physics of the Air" may well be regarded as an answer to this indictment of physicists for neglect. In part it meets the demand of aerologists for a special, up-to-date treatise. But here a strange condition of affairs confronts one. For physics today is not the established, slowly changing physics of a few years back; but a more complex and rapidly changing study of the structure of the atom, modifying views heretofore held as fundamental in astronomy, biology, chemistry, geology, and mechanics.

In fact the favorite occupation of physicists now seems to be "giving a jolt" to classical dynamics. One may not reasonably then expect a book on physics to be strictly up-to-date; unless the volume comes hot from the press. Where publication is delayed a technical treatise is sure to suffer. In the present book one looks in vain for recent determinations of Planck's constant, the value of the electron charge, molecular weights, and atomic numbers.

Professor Humphreys states that the book is an attempt to present "an orderly assemblage of facts and theories connected with the physics of the earth's atmosphere." Mechanics might well be added. The volume originated in a series of lectures delivered at an aviation school in 1914; and these have been expanded, revised, and from month to month printed in the *Journal of the Franklin Institute*, 1917–1920. Many of the diagrams and much of the text are reproduced with slight changes from articles by the author and others in Weather Bureau publications.

There are four parts: I, Mechanics and Thermodynamics; II, Electricity and Auroras; III, Optics; and IV, Factors of Climatic Control.

The book is rather weighty; too large, we think, for convenient handling; but this is doubtless because of the extent of the field covered. Would it not have been better, to have excluded, as far as possible, the chapters on Vulcanism, which are geophysics rather than aerophysics? Part IV, as the author says, "is a discussion of the physics of climate but not of its geographic distribution" which is Hamlet with Hamlet omitted. The subject is one of such importance and of so much interest to others beside meteorologists that we venture to express a hope that Professor Humphreys will amplify this portion of the book in a separate volume, to be called perhaps "Evolution of Climate."

Part II, entitled "Atmospheric Electricity and Auroras," consists of two chapters, nineteen pages. Would it not have been more appropriate to include under Part II, Chapters XV and XVI on Thunderstorms and Lightning now in Part I? More especially so, because Part I is disproportionately long, consisting of sixteen chapters, four hundred twenty-five pages, a book in itself.

Part III deals exhaustively with optical effects, and is drawn chiefly from Pernter and Exner's "Meteorologische Optik," supplemented by some of the papers of the former Lord Rayleigh published in the *Philosophical Magazine*. Here the work of a distinguished American (Barus) on Nucleation has apparently been overlooked. Refraction phenomena are dealt with at great length. There is an interesting explanation of the "green flash" as a refraction effect.

On page 448 is an amusing paragraph with the fine flavor of a problem in relativity: "It is conceivable therefore, that the size of a planet and the vertical density gradient of its atmosphere might be such that one's horizon on it would include the entire surface—that he could look all the way round and, as some one has said, see his own back." Some doubting Thomas will at once ask, "What kind of a temperature distribution could produce such a density lapse rate?"

Looming, towering, sinking, and stooping; also superior and lateral mirage are terms used and defined; and we suspect that some of these are freshly coined. There is, however, no specific definition of visibility, nor its complement obscuration; or tables such as are now used at aviation centers.

The volume being quasi official, a wider range of criticism may be permitted than ordinarily would apply; and so we feel forced to point out that Chapter I, headed "Observations," is of a prewar order, not up to the requirements of the present time and certainly not up to the high level of the rest of the book. There are time-worn illustrations of a Robinson anemometer and a sling psychrometer but only the barest mention of Dines' pressure-tube anemometer and the modern humidity instruments. To be sure, elsewhere in the book a pressure-tube anemogram is given to illustrate gustiness; but, even then the record is an old one [Aberdeen, January 6, 1908], in fact one of the earliest, one in which the wind direction is not automatic but is added by hand. So many excellent anemobiograph records are available that the selection must be regarded as inadequate.

It may also be noted that the reference given on page 221 to this pressure-tube trace is

erroneous; as Figure 31 is an assumed temperature gradient. A minor error occurs on the same page regarding billows in the low atmosphere and pressure changes of 0.1 mm. to 0.3 mm. Figure 57 is an old-fashioned scale in inches, not millimeters as the text requires. Again, the elevation of the station is omitted; and so we have the incongruity of a pressure curve representing an anticyclone in which the pressure reading is 29.05 inches. On page 227 the scales are again confused.

In the discussion of tropical cyclones, no mention is made of the work of Algué, Froc, or Fassig; and one looks in vain in the index for "*baguio*," "hurricane," and "typhoon"; and yet "bumps" is duly given. The work of Bigelow, Barus, both Bjerknes, Cave, Dines (J. S.), Dobson, Eiffel, Margules, Rotch, and many others is not mentioned. Certainly Bjerknes's graphic methods of dynamical meteorology and Bigelow's explanation of the origin of cyclones, whether accepted or not, should have been referred to; as well as the various papers of the latter on circulation and radiation in the atmosphere.

Some confusion exists in the use of units and symbols. *R* for example, is employed as symbol for gas constant, ohmic resistence, radius of rain-drop, radius of the earth, rain, and resultant amplitude. In general Professor Humphreys keeps closely to the Centigrade scale and C. G. S. units. In formulae for gradient winds, pressure differences are expressed in dynes per square centimeter which is now becoming general in aerographic literature. But, notwithstanding this, the meteorological bar is used and not the bar of the physicist.

ALEXANDER MCADIE

THE PREDICTION OF MINIMUM TEMPERATURES

J. WARREN SMITH, AND OTHERS. **Predicting Minimum Temperatures from Hygrometric Data.** 76 pp.: maps, diagrs., ills., bibliogr. *Monthly Weather Rev. Suppl. No. 16.* U. S. Dept. of Agriculture, Washington, D. C., 1920.

The need for predicting minimum temperatures is imperative in fruit regions where the growers must protect their crops against freezing. But fruit growers cannot afford the expense of protection every time the temperature *may* fall dangerously low; so an accuracy of prediction within two or three degrees (F.) is practically required when temperatures in the twenties are expected. Since most methods of protection are useless on windy nights, profitable fruit growing is confined to regions where at critical seasons the temperatures do not fall much below freezing except on clear, quiet nights. The forecaster's problem, then, is to pick, from weather map indications and the local aspect of the sky, the nights which will probably be clear and then to compute how low the temperature will fall. Under clear skies the rate of cooling is closely dependent on the moisture content of the air—dry air favoring strong radiation and a large fall in temperature. Thus, observations of humidity in the afternoon or evening can be used to predict accurately the next morning's minimum temperature when a clear night with but little wind is expected.

This collection of papers, prepared under Professor Smith's guidance, shows in detail how hygrometric data are used in actual practice in different fruit regions. Graphical and statistical methods brought into action insure the employment of the best means and the greatest accuracy at present attainable. The observations of a central station in a fruit region can be used for predicting minimum temperatures at places even several miles away, once the usual temperature differences between the central station and the outlying locality are known. Thus, if the central station has some years' length of record, only a few months' observations in different orchards are necessary before accurate local temperature forecasts are possible.

Aside from the discussions centered about the use of hygrometric data, two contributions deserve special mention. On pages 20–30 Dr. H. J. Franklin has presented a detailed discussion of "Cape Cod Cranberry Frosts," how forecast, the temperature resistance of cranberries in different stages, and ways to protect bogs from frost. On pages 46–49 Mr. J. Cecil Alter discusses "Forecasting Minimum Temperatures in Utah" especially "for sheep shearing and lambing and fruit-raising interests in spring; alfalfa seed, tomato, and vegetable interests in autumn; and shippers of perishable products and users of stream flow for hydroelectric purposes in winter." . . .

A specialized bibliography of 12 titles closes the group of papers.

CHARLES F. BROOKS

In Praise of the Map

W. P. James. **The Lure of the Map.** 2nd edit. vii and 120 pp. Methuen & Co., Ltd., London, 1920. 7 x 4½ inches.

The writer of this delightful little collection of literary essays informs his readers that if he had to choose one work to take with him to a desert island he would take an atlas. Surely the book of a man who thinks in this way deserves to be brought to the attention of geographers.

Six of the seven essays deal with subjects related to geography. The first, from which the collection takes its title, reveals the fascination of maps both ancient and modern. "Local Colour" tells of the search and conquest by novelists of an elusive genius loci. "Odysseys Old and New" analyses with a light hand the appeal that unknown countries have always made to the imagination, and "In Excelsis" carries the reader among mountain crags and snows with the Alpinists of the last two centuries. "Of the Lineage of Yorick" opens up the world of those men whose feeling for the spirit of foreign lands was truest—Borrow, Stevenson, Kinglake, Doughty, and others; while, in conclusion, "Pilgrims, Pirates, and Merchant Adventurers" introduces us to the possibilities of that most vital and absorbing field of historical study, the history of geographical discovery.

Quite apart from the charm of its own style and substance, this book serves as an admirable introduction to those works of travel which have achieved recognition and maintained a high place in English literature.

CORRESPONDENCE

A letter received from Mr. L. C. W. Bonacina of London, England, takes up the discussion of the philosophy of natural beauty thus:

The note by Professor Davis in the *Geographical Review* for December 1920 prompts me to reply to the difficulty which he proffers about the intrinsic nature of landscape beauty, whether objective or subjective reality. Apart from Sir Francis Younghusband's representations in the *Geographical Journal* for July, 1920, which I most ardently uphold, I have myself been up against Professor Davis's question in deciding to what extent the discussion of natural beauty should find place in a work I am planning on the climate of England. To unravel this metaphysical intricacy one must first of all bear in mind that natural phenomena may be studied in regard to (1) their causes, (2) the actual phenomena themselves, (3) their effects. Now physical beauty can, I submit, be defined, for present purposes, as an effect of material dispositions upon the human mind and soul, and, therefore, may properly be discussed in scientific works under (3) above. In a strict sense, of course, all physical phenomena are only known as effects upon the mind which perceives them; but I employ the term "effect" to denote less direct influences such as, for example, that of environment upon the human mind and body. Thus a tree may be "beautiful" because the total disposition of material elements composing it endows the tree with a kind of personality which pleases and inspires the spirit. Consequently, while it is always right to express in a book what we *feel* about the beauty of mountain, tree, cloud, or other elements of landscape, it is only philosophical to discuss what we *know* of the beauty in writings which treat of the effects of physical phenomena as distinct from the things in themselves. This conclusion does not refute the proposition, quoted by Professor Davis, that "beauty is truth, truth beauty," that beauty is, indeed, an eternal verity; but it does demonstrate that high imaginative and intellectual faculties are required to comprehend and interpret the quality of beauty,—as it certainly postulates Omniscient Power behind the evolutionary processes of the universe.

The metaphysical explanation of natural beauty may perhaps be rendered clearer by considering the simpler case of light. Objectively, light consists of electro-magnetic undulations in a medium, but light as light is a subjective reality only in relation to sentient beings. Similarly, the objective foundations of beauty are infinitely varied and complex; but beauty as beauty is subjective, and exists only in relation to self-conscious beings.

L. C. W. Bonacina